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Factory

MANAGEMENT and MAINTENANCE

September • 1934

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Factory Management and Maintenance, September, 1934. Vol. 92. No. 9. Published monthly. McGraw-Hill Publishing Company, Inc., 330 West 42d Street, New York, N. Y. Entered as second-class matter March 17, 1933, at Post Office at New York, N. Y., under the Act of March 3, 1879. Printed in U. S. A.

Printed by The Schweinler Press, N. Y.

Factory Management *and* Maintenance

A consolidation of *Factory and Industrial Management* (including *"Factory"*) and *Maintenance Engineering*

SEPTEMBER • 1934

Make an Investment of Production Planning..... R. H. ROSITZKE 381
Old and new requirements are reconciled, duties of planning division given in this article

Had to Hire 2,200 Girls *Quick*..... RICHARD E. SMITH 384
Dexterity tests helped Hygrade Lamp pick those best suited for its special type of work

This Is the Way One Plant Rotates Its Shifts..... 386
One successful way of adjusting 24-hour-per-day operation to 40-hour-per-operator week

Aluminum Arrives..... LEWIS K. URQUHART 387
More about a comparatively new metal, how far it has gone, where we may expect it to go

People with Hobbies Are Better Workers..... 389
Toledo Scale had a hobby show, found it good, makes it regular part of personnel program

More Work from Tiering Trucks..... 390
Versatile pieces of handling equipment, these tiering trucks; they'll tackle 'most any job

Labor Costs in Advance by Formula..... THOMAS L. HAPGOOD 391
Not so formidable as they look, formulas are useful in getting labor costs on new jobs

Motion Study, Mr. Safety Man, Makes Any Plant Safer.... ALLAN H. MOGENSEN 393
The motion study way is the right way of doing a job and the right way is the safe way

40 Foot-Candles..... 395
Isn't too much light for fine work—printing or assembling galvanometers for instance

Dust Is Out..... 396
Must always be out if the health of industrial workers is to be preserved—and it must

"Management and Labor Are in the Same Business"..... 397
A statement of General Motors Corporation's basic policies governing employer-employee relationships

Daily Maintenance Bills..... WILLIAM R. MULLEE 402
Enable foremen to check up immediately on what the maintenance department does for them

Watching Power Costs?..... 403
Visible and audible alarms help one concern stay within the limits of its rate schedule

Supporting Shafts and Motors..... C. A. BADEN 404
Details of methods that provide rigidity, ease of erection, flexibility in case of change

More Orders! Then What?..... O. L. MERKT 408
Factory buildings, for one thing, must be ready, services in order. Specific things to do

Line Starting of D.C. Motors..... L. E. MARKLE 409
Best operating conditions for a given installation may depend on how connections are made

What Type Electric Heating Units?..... R. M. CHERRY 411
Construction of units and a discussion of the industrial uses for which they are intended

16 Basic Maintenance Principles..... C. J. STUART 413
Fundamental philosophy compressed for quick reading into a single magazine page

How to Maintain Instrument Accuracy..... J. SAYRE CHRISTIE 414
Ten things you always do, ten more you never do if you want to keep meters right

Saving by Welding..... 416
That day welding counts lost in which industry does not give it another job to do

Management Shorts 399
You Want to Know..... 400
Editorials 401
Maintenance Shorts 417
Questions and Answers 420
Equipment News 421
Trade Literature 424
Books .....Advertising Page 84

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Price 35c. a copy. Subscription rates—United States, Mexico, and Central and South American countries, $3 a year. Canada, including duty, $3.50 a year. All other countries, $4 a year or 16 shillings. Cable address, "McGrawhill, New York." Member of A.B.P. Member of A.B.C. Copyright, 1934, by McGraw-Hill Publishing Co., Inc., 330 West 42d Street, New York, N. Y.

NRA CODE GRAPHIC ARTS INDUSTRY 1934

McGraw-Hill Publishing Co., Inc., 330 W. 42d St., N.Y.

Branch Offices: 520 North Michigan Ave., Chicago; 883 Mission St., San Francisco; Aldwych House, Aldwych, London, W. C. 2; Washington; Philadelphia; Cleveland; Detroit; St. Louis; Boston; Greenville, S. C. James H. McGraw, Chairman of the Board; Malcolm Muir, President; James H. McGraw, Jr., Vice-President and Treasurer; Mason Britton, Vice-President; H. C. Parmelee, Vice-President; Harold W. McGraw, Vice-President; B. R. Putnam, Secretary.

New Deal. Labor costs up. Materials costs up. But cost of production must go down. One thing can help—power costs still are controllable. So,

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Feature Articles

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How to Generate Power Economically
How to Buy Power Economically
How to Transmit Power Economically
Lubrication as a Power Loss Preventive
Correct Motor Application to Conserve Power

and

A Power Loss Check Sheet

showing preventable losses, recoverable losses, and unavoidable losses in the generation, transmission, and utilization of power

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Extra editorial pages to do this job. All regular articles and departments as usual.

FACTORY MANAGEMENT and MAINTENANCE

SEPTEMBER, 1934

IN REVISING PLANNING METHODS:

Define requirements of the Planning Division
Analyze minimum wage allowance losses
Use planning short cuts
Schedule personnel requirements to eliminate waiting
Dehydrate piece rates
Make contents of pay envelope conform to time worked
Allow latitude to foremen
Measure effectiveness of performance

Make an Investment of Production Planning

R. H. Rositzke
R. H. Rositzke and Associates
New York

WE HAVE entered a new era. Manufacturers are responsible for the idle time of employees. Whether employees are on bonus, piece work, or day rate, the employer must make up the difference between the minimum wage and the amount an employee earns if such earning is below the minimum requirement. This simply means that a period is facing employers wherein they will have to schedule personnel requirements accurately or suffer excessive minimum wage allowance losses.

Analysis of what such losses will amount to over a period of a year is convincing in most cases. It definitely indicates the monies that can be expended for controlling labor through planning measures and the return a company will receive on its investment. The chart shown on the second page following was drawn up, in my analysis of one particular case, covering a department of skilled workers. Piece work rates were in effect. It was decided to select one year's earnings for analysis. Thereafter the actual earnings per hour were computed weekly for each employee.

The highest average and lowest earnings per hour, based on weekly performance, were selected. Employees were classified by length of service as indicated by four group captions. Forty-three cents per hour was the minimum wage. Note the number of low hourly earnings that fell below this minimum requirement. Sixteen employees out of forty-three had at least one week in which their pay would have to be brought up to cover minimum wage, although the department averaged an earning of sixty-three cents, twenty cents more than minimum requirement.

This analysis covers only one of this company's departments, and, at that, in a center where the rate levels are highest. The weeks that indicated the greatest minimum wage allowance requirements always followed a change in the production cycle both on the upswing and down grade. The factory, without a coordinated planning method, is not sufficiently in touch with delivery requirements to do anything other than play safe as to personnel. Its long experience with delivery schedules, unless they are definitely planned for, has been to pile in the help when there is a sign of increase and to hang on to the men as long as possible. It was all right to make the employee take it on the chin in the old days. Today waiting time has to be paid for. Let's see how planning can help.

Manufacturing Department

DIVISION: Production Planning
HEAD OF DIVISION: Production Planning Manager
REPORTS TO: Works Manager

General Scope of Division

The Production Planning Division is responsible for making effective the computation and scheduling of material, and the estimating of men and machinery required to complete items for given scheduled periods that will insure, insofar as possible, an even flow of production.

It is also responsible for laying out, scheduling, and ordering special orders, establishment of reasonable factory delivery dates, and the fulfillment of the same.

In addition, it is the duty of this division to balance its schedules and so supervise its stock as to obtain a maximum of production commensurate with a minimum inventory of fabricated parts and material purchased for use in manufacture.

General Duties of Production Planning Manager

It is the duty of the Production Planning Manager to assume full responsibility for the carrying out of the activity of his division as herein outlined. The task of developing key men for his subordinate sections, and the delegation of full responsibility to them, in addition to the development of the most likely subordinate as an understudy, is a prime function.

Specific Duties of Division

1. To accept sales estimates and special orders and revisions thereof, and break them down into terms of sub-assemblies, parts, and raw material requirements.
2. To correlate on the printing plates the manufacturing description and operation numbers, together with the standard time required, and, in case of fabricating, major machine designation.
3. To establish schedule dates for issuance of orders; to compute intervals required in assembly, manufacture of parts and sub-assemblies; and to establish schedule dates for the purchase and receipt of raw materials and the current revision thereof to meet changing conditions.
4. To establish maximums and minimums on all sub-assemblies, parts, and raw materials included in the standing manufacturing schedule, and to make periodical reviews of special demand against standing order items, in order to effect proper maximums and minimums, and to avoid transferring of parts and materials to accommodate other than regular items. (These periodical reviews should be submitted to the Works Manager.)
5. To render a prompt delivery service to the various sections and at all times investigate deficiencies in stock where ledger balances indicate quantities available.
6. To establish waste factors in conjunction with the Time Study and Cost Divisions, and to allow percentages deemed normal in the specifications of manufacturing quantities.
7. To follow deliveries against promises and completion of standing orders, and to keep records of promise performance.
8. To maintain complete records of all materials purchased for use in manufacture, fabricated parts, and sub-assemblies, showing material needed, material ordered, material assigned, and material on hand.
9. To supervise the physical handling in stockrooms of all fabricated parts, sub-assemblies, and material purchased for use in manufacture, including the checking in by count or weight, storage, and issuance on the receipt of proper requisition.
10. To make out, at time of making out manufacturing order, requisitions to cover the issuance of all material necessary for the production of the items covered by the manufacturing order.
11. To review existing methods of storing within and between sections and units, to record such methods in written form, and to render to the Works Manager suggestions for the improvement or correction of existing conditions or methods.
12. To lay out trucking schedules on the above for best service to all sections interested with a minimum of delay and inconvenience.
13. To maintain all trucking and bin equipment in proper shape, and to report promptly any and all needed repairs.
14. To supervise the layout of all storage space, so as to accommodate a maximum of stock with a minimum of labor, handling, and waste space.
15. To keep advised as to the latest developments in boxes, trucks, platforms, etc., and to recommend the procurement thereof to the Works Manager, wherever changes or betterments are deemed advisable.
16. To suggest ways and means of eliminating time and expense in the handling of all materials.
17. To maintain constant supervision of inventories, and to suggest ways and means of consuming slow-moving and obsolete stock of parts and materials purchased for use in manufacture. (Where the division is unable to make disposition of this material, a report shall be made to the Works Manager, requesting disposition.)
18. To follow up closely these slow-moving and obsolete items to maintain them at a minimum for the conservation of floor space as well as monetary investment.
19. To cooperate at all times with the other manufacturing and sales service divisions to the fullest extent to keep at a minimum any feeling of friction between the company and its customers.
20. To compare the estimated schedule of men and machinery requirements against the actual available, and, where major differences appear, to submit a notification thereof to the Works Manager.
21. To make report to the Works Manager at specified times of the amount of work ahead of various sections in standard hours, so that the management may accurately gage the results of past efforts, and also plan properly for future operations.
22. To assume full responsibility for the methods employed and the efficiency thereof in all subsidiary planning sections within the factory, and to report all major unauthorized deviations or careless manipulations thereof to the Works Manager.

Subordinate Sections and Heads

PRODUCTION ORDER AND SCHEDULING:
Chief Dispatcher

STORES RECORDS: Chief Ledger Clerk

FACTORY STOCK CONTROL:
Material Control Supervisor

Dehydrating Piece Rates

Executives seeking avenues for manufacturing cost reductions do not seem to realize the full strength and value of production planning if properly tuned up to meet code requirements. It is an unobtrusive way of taking the water out of a great many apparently satisfactory piece work rates and greatly reducing minimum wage allowances without antagonizing the rank and file of factory personnel.

A great many of us remember the pre-war and war-time expansion planning methods. Everything was scheduled from the smallest department to the largest. Equipment and man power were scarce and material delivery un-

certain. The cost of planning was unimportant. Whoever made deliveries got the business and profit was inevitable.

Thereafter a gradual but certain retrenchment was made effective in the cost of planning, climaxed by depression emergency measures which eliminated a great many worthwhile planning divisions and their activities. Expense cutting, irrespective of the soundness of measures taken, was the pass-word.

Old and New Planning Requirements Reconciled

Many of the old planning schemes were discarded because they were top-heavy or considered as belonging to the service divisions that would have to go for the sake of obtaining economies. Executives today are service-department cost-minded. Therefore, in bringing back our planning divison, we shall have to do more than just pull out our old planning schemes and re-establish the methods of yesterday.

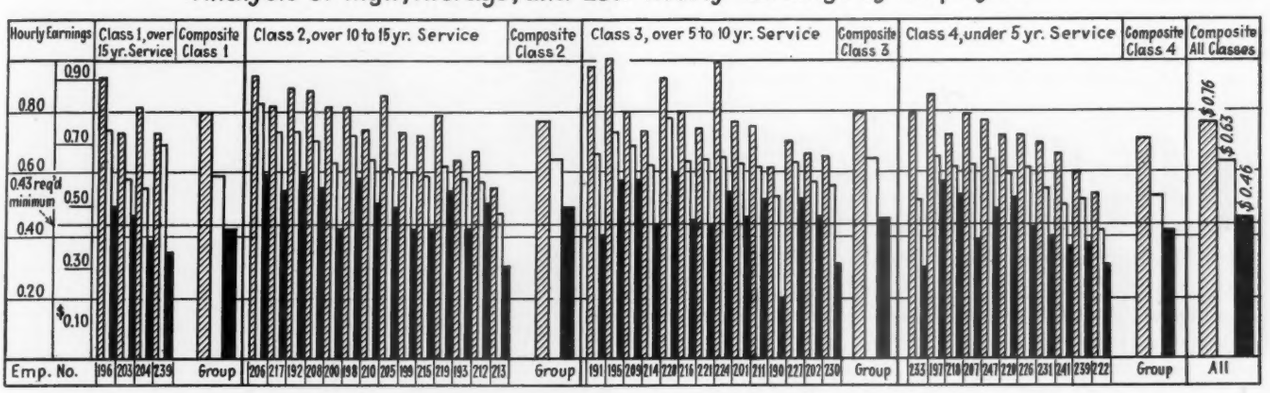
Instead of detailed control and a very elaborate system covering many non-essentials it will be necessary to plan basic requirements properly.

In line with this thought, a schedule covering the requirements of a planning division is shown. A definition of the requirements in the planning division, preceding the establishment of the actual mechanics of the system itself, will invariably reduce the detailed clerical necessities of this function. *(Continued on advertising page 48)*

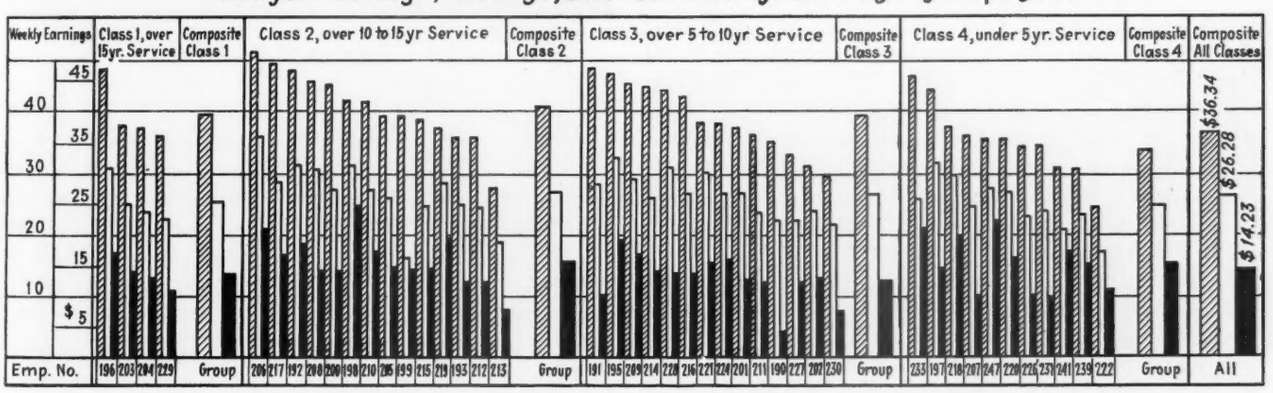
GRAPHIC REVIEW OF PIECE WORK EARNINGS

ANALYZED FOR HIGHEST, AVERAGE, AND LOWEST HOURLY AND WEEKLY EARNINGS BY OPERATORS

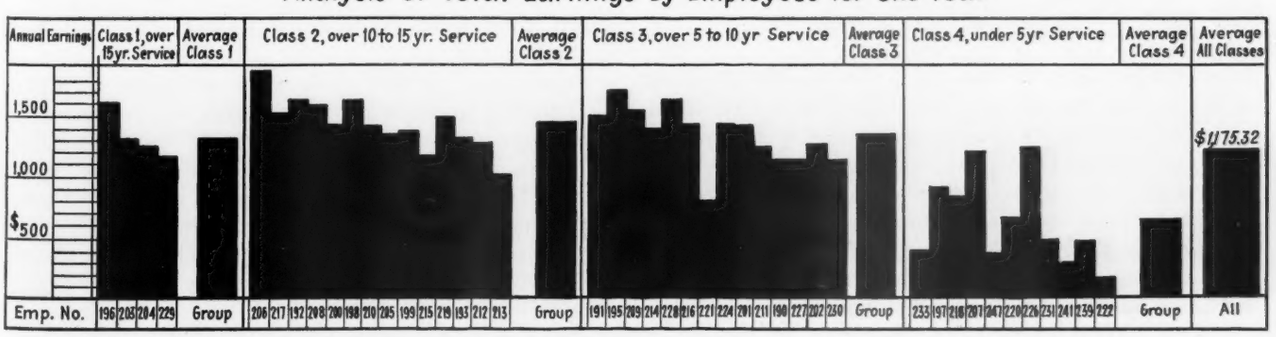
Analysis of High, Average, and Low Hourly Earnings by Employees



Analysis of High, Average, and Low Weekly Earnings by Employees



Analysis of Total Earnings by Employees for One Year


Annual Earnings
Class 1, over 15 yr. Service
Average Class 1
Class 2, over 10 to 15 yr. Service
Average Class 2
Class 3, over 5 to 10 yr Service
Average Class 3
Class 4, under 5 yr Service
Average Class 4
Average All Classes
1,500
1,000
$500
$1175.32
Emp. No.
196 203 204 229
Group
206 217 192 208 200 198 210 205 199 215 219 193 212 213
Group
191 195 209 214 228 216 221 224 201 211 190 227 202 230
Group
233 197 218 207 247 228 226 231 241 239 222
Group
All

Applicants are interviewed . . .

Had to Hire 2,

Richard E. Smith
Production Engineer
Hygrade Sylvania Corporation
Salem, Mass.

. . . tested for finger dexterity . . .

THE BLUE EAGLE has not been easily won and held by the manufacturer who is observing NIRA regulations to the very letter. The shortened work week has sometimes doubled the factory force in a very short space of time, thereby imposing special problems bearing on the selection of labor. If, in addition, the industry affected has found itself in one of its seasonal rush periods, an outsider can hardly appreciate the magnitude of the labor recruiting and selecting activities involved.

This situation overtook the electric lamp bulb and radio tube industry a year ago August, at which time the Hygrade Sylvania Corporation was employing 2,500 people in its factories in Salem, Mass., in Emporium and St. Mary's, Pa., and in Clifton, N. J. The peak of production came in October when the payroll mounted to 4,750—an increase of 2,250 employees or 90 per cent.

Besides the necessity of examining rapidly the hundreds of applicants for jobs to be filled immediately, as well as the need to satisfy the management that these selections were the best possible, we found that we were hiring from a new labor group—a mixture of skilled and unskilled factory workers and former office employees now in open competition with the usual run-of-the-mill hands. It was our problem to find the best workers among the lot.

Testing 50 Girls a Day

As the first step we devised a test suitable to grade applicants into various classifications from which could be drawn the workers needed in the stem, parts, mount, sealing-in, and packing departments. Hiring as we were an average of 50 girls a day, with the best personnel material we have ever seen coming to our door, we had to make the tests simple yet effective enough to weed out the totally unfit, and those "un-manual." The tests had to be adaptable to fast, individual use.

We were, one might say, looking for the "ideal factory girl" for our kind of work. This ideal worker would be young, healthy, have fine eyesight, be able to use her fingers nimbly and quickly, and capable of handling tools and machines with intelligence. Finally, we should know that her home life and outside conditions were good.

Any single test could not, of course, give us the answers to all those questions. A combination of tests could. We worked out, therefore, two broad methods. One would test the applicant's aptitude for factory work, as well as physical condition to make this ability of value. The other was a "human record" of the applicant—purely sociological in import. We are interested here in the first test only.

Because our factory work requires definite ability in the handling of materials with fingers and tweezers, we selected two of the original aptitude tests developed by Johnson O'Connor and described in his book "Born That Way." When we first considered using these tests, a thorough investigation was made in the factory to check their value by testing a large number of employees of known ability and performance. The results indicated conclusively that the kind of work done in our plant was

re 2,200 Girls *Quick*

Some job! But dexterity tests helped us pick those best suited for our class of work

Table I—Performance Time

TWEEZER DEXTERITY TESTS

	Male	*Female*
Graded A	0–5.00 min.	0–5.40 min.
Graded B	5.01–5.60	5.41–6.20
Graded C	5.61–6.20	6.21–7.30
Graded D	6.21–Up	7.31–Up

FINGER DEXTERITY TESTS

A (Fastest Quarter)	0–4.08 min.	0–3.66 min.
B (Second Quarter)	4.09–4.40	3.67–3.98
C (Third Quarter)	4.41–4.76	3.99–4.29
D (Slowest Quarter)	4.77–Up	4.30–Up
Fastest Person	3.08	2.87
Slowest Person	8.50–Up	7.50–Up

The figures in this table are from "Born That Way" by Johnson O'Connor.

. . . given the tweezer test . . .

such as to make the O'Connor tests of great value in selecting employees.

The only apparatus used in the finger and tweezer dexterity tests are two pin boards of similar construction, a stopwatch, and a comparison table of performance. The pin boards are of the same size for the two tests. The base, made of aluminum and designed to prevent

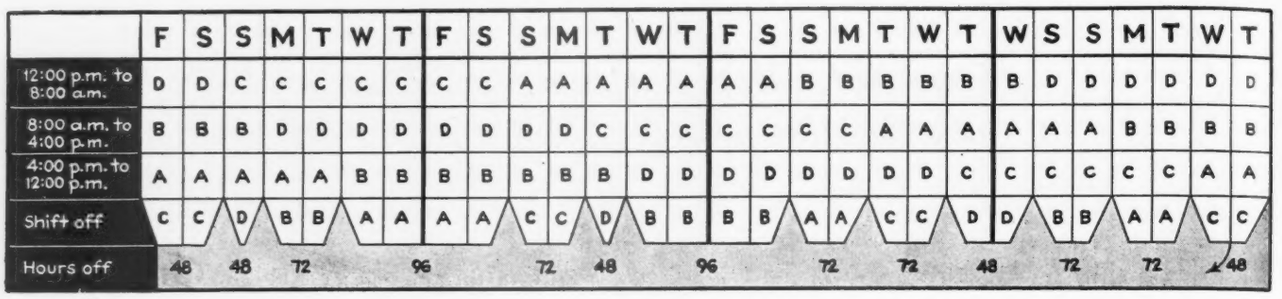
(Continued on advertising page 60)

Table II—Procedure for Hiring

Operation	*First Choice* FD	TD	*Second Choice* FD	TD	*Do Not Hire* FD	TD
STEM DEPT.						
Stem making	A	...	B	...	C or D	.....
Bead making	A	...	B	...	C or D	.....
Stem shaping	Pick from C's and D's					
Bead shaping	A	...	B	...	C or D	.....
Inspection, floor work	Pick from C's and D's					
PARTS DEPT.						
All production jobs except as below	A	...	B	...	C or D	.....
Threading operations	...	A	...	B	.....	C or D
All tweezer jobs	A	A	B	B	C or D	C or D
Inspection, floor work	Pick from C's and D's					
SEALING-IN DEPT.						
Threading on units	A	A	B	B	C or D	C or D
Tubulating	A	...	B	...	C or D	.....
All other jobs	Pick from C's and D's					
PACKING DEPT.						
All jobs	A	...	B	...	C or D	.....
MOUNT DEPT.						
All production jobs	A	A	B	B	C or D	C or D
Inspection, floor work	Pick from C's and D's					

. . . and go to work

This Is the Way One Plant



	F	S	S	M	T	W	T	F	S	S	M	T	W	T	F	S	S	M	T	W	T	W	S	S	M	T	W	T
12:00 p.m. to 8:00 a.m.	D	D	C	C	C	C	C	C	C	A	A	A	A	A	A	A	B	B	B	B	B	B	D	D	D	D	D	D
8:00 a.m. to 4:00 p.m.	B	B	B	D	D	D	D	D	D	D	D	C	C	C	C	C	C	C	A	A	A	A	A	A	B	B	B	B
4:00 p.m. to 12:00 p.m.	A	A	A	A	A	B	B	B	B	B	B	B	D	D	D	D	D	D	D	D	C	C	C	C	C	C	A	A
Shift off	C	C	D	B	B	A	A	A	A	C	C	D	B	B	B	B	A	A	C	C	D	D	B	B	A	A	C	C
Hours off	48		48	72		96			72	48		96			72		72	48		72		72		48				

Rotates Its Shifts

and overcomes the seeming difficulty of running 24 hours a day on a 40-hour-per-operator week

IN PLANTS that run 24 hours a day the problem of arranging shifts so that foremen, supervisors, and men alike will work 40 hours a week may look like a hard nut to crack.

It needn't be. Witness a plan that has been in successful operation since last September.

Here the *old* way was to run three shifts and to carry relief men on each shift. The disadvantage was that the crew was always changing; different men were on different jobs every day in the week.

The *new* plan is best described by referring to the shift rotation schedule here illustrated.

Four shifts are provided. Three of them—marked *A, B* and *C* on the schedule—have enough men to run the job with no relief men. The necessary two days off per week are provided by substituting a relief shift —indicated as *D*.

This schedule covers a 4-week period, and the payroll weeks run from Friday to Friday. The 40 hours per week are, of course, figured on the payroll instead of the calendar week.

When *A* shift, for example, goes on at midnight on Sunday, it works on the midnight-to-8-a.m. shift for seven days straight. Only five of those days, however, are in one pay period. The remaining two are in the next. *A* shift then goes off at 8 a.m. on Saturday, stays off 72 hours, comes on again at 8 a.m. on Tuesday. It then stays on for six days—three of them falling into each of two pay periods—continues through till 4 p.m. on Sunday, stays off another 72 hours, resumes work at 4 p.m. on Wednesday.

So with shifts *B* and *C*. Note that all three have a week-end off every four weeks.

Meanwhile *D* shift, being the relief shift, operates somewhat differently. Note, for instance, that it works *six* days in each payroll week. It is therefore necessary to provide relief men on this shift—but on this shift only—so that each operator may be off one day in addition to the day the whole shift is off. In this way the men on *D* shift work only 40 specified hours. Also it has men on it who are capable of relieving foremen and supervisors so that they, too, will work only 40 hours.

The important advantages of the plan are that each shift works as a unit; each man on it has his own job; there is none of the constant shifting and relieving that was so inevitably a consequence of the old three-shift plan.

▼

What's holding up that order?

An embarrassing question. But seldom asked nowadays in one Connecticut plant. A control plan has put an end to all that. Boy does paperwork; there isn't much. Foreman is free to get out production. Read all about it in October

Lewis K. Urquhart
Associate Editor

Aluminum Arrives

More about its war on weight, its increasing influence in transportation and architecture, its growing popularity in a wide range of uses

Aluminum closures of various types answer the liquor industry's need for tamper-proof seals and better-looking packages

ONE OF these days, prophesied an advertisement that appeared in 1930, you will ride on an aluminum train. That prophecy was fulfilled in 1934. Last February the first of Union Pacific's new three-car articulated trains took to the rails.

Powered by a 600-hp., 12-cylinder, distillate-burning engine with electric transmission, it weighs approximately 85 tons—about the same as an ordinary sleeper—and represents a combination of the scientific development of aeronautical, automotive, and railroad design. Lowest possible cost of operation commensurate with high speed and complete safety was the chief aim of those who built it. How well they have succeeded is proved by the fact that only 500 horsepower—your automobile is rated at least 50, no doubt—is required to move it at 90 miles an hour. It would take perhaps 3,500 horsepower to propel a conventional 10-car train at the same rate of speed.

The car bodies are made of extruded aluminum alloy shapes in combination with aluminum alloy plate forming the inner and outer sheathing.

Aluminum alloys are in fact used for the entire structure except bolsters, articulation castings, and truck frames, which are of special cast steel. The extruded shapes permit an economical distribution of metal not possible with conventional shapes, and provide for ample strength and safety with minimum weight. They can be designed to fit the contour of the structure as opposed to the usual requirement of designing the structure to fit the shapes.

Not to be outdone by Union Pacific with its all-aluminum train or by Burlington with its stainless steel Zephyr, B & O has ordered two high-speed trains, one aluminum, one steel, thereby maintaining strict neutrality in this interesting rivalry between metals. Both will be 8-car trains powered by steam.

"The World Do Move"

Up in New England they'll also be having one of each. New Haven, newest convert to the aluminum way of transportation, has told the world about a stream-lined train in that metal, with diesel-electric driving units, one before and one behind, operating in unison. To keep the record straight—and possibly to preserve the balance of power—Boston and Maine will have its stainless steel flyer.

How surely "the world do move" is nowhere better shown, perhaps, than in the Travel and Transportation Building at A Century of Progress. Old No. 9, the first Pullman sleeping car ever built, and its modern counterpart, the George M. Pullman, stand there side by side. No. 9, in case you don't remember, was a veritable palace on wheels when it was built back in '59. Steel in time replaced its wrought iron and wood, and in 1907 the first all-steel sleeping car was exhibited to an admiring populace at the Jamestown Tercentennial.

That *was* progress. Yet it pales into insignificance when compared with the advances of the past quarter of a century. Think, for example, of a standard steel sleeper that weighs 180,000 pounds. Then picture the George M. Pullman, all-aluminum and half as heavy. With air-conditioning equipment, extra large generators, heavy batteries, and full supply she tips the beam at only 96,980 pounds.

That *is* progress.

Ten thousand pounds of dead weight is saved in the

Some of the many hundreds of screw machine products which industry is fashioning from aluminum

trucks alone because they have been aluminized and because the lightness of the superstructure made possible a reduction from six to four wheels. The six-wheel truck had been Pullman practice for 68 years, but it is quite probable that aluminum is too young to know about such hallowed traditions.

These and similar uses of aluminum are, of course, no idle experiment. They are based on a sound experience. All told, 2,258 cars and locomotives have been built with aluminum applications since 1923. Of them, 995 are in service on the railroads, 1,263 on electric street and rapid transit railways. Between them they have engineered the elimination of 1,300,000,000 ton-miles of dead weight.

Some of those aluminum street railway cars—we haven't checked up on this, but if there are such street cars anywhere, there ought for obvious reasons to be some in Pittsburgh—are now running over an aluminum bridge.

Some years ago the good burghers of Pittsburgh discovered that the old Smithfield Street Bridge, principal crossing over Monongahela since its construction in 1882, was carrying far heavier loads than originally intended. To make a long story short, but to give scant recognition to a notable structural engineering feat, the entire floor system of the bridge was rebuilt. Aluminum alloy replaced old wrought iron and steel members, and on them was laid, not a heavy timber flooring, but a battle-deck type of floor made of aluminum plate and channels surfaced with asphalt and weighing only 30 pounds to the square foot.

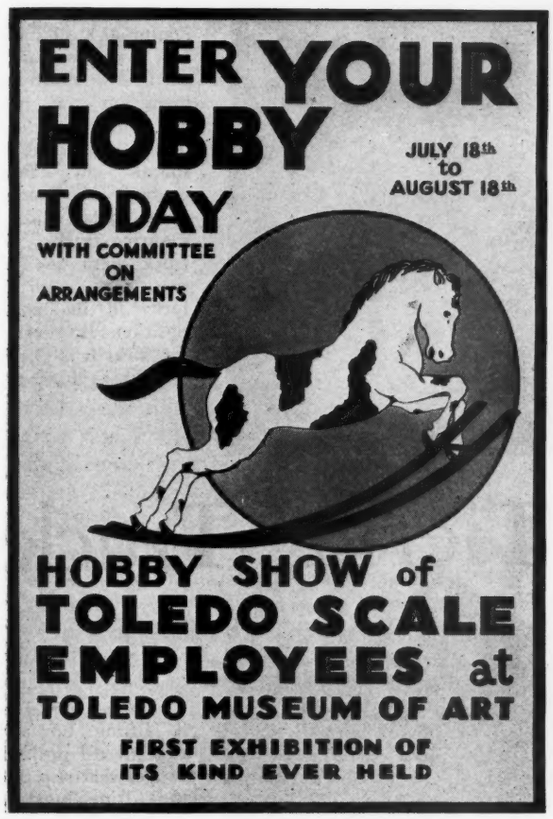
In that way 700 tons of dead weight was removed from the load carried by the ancient trusses, and a bridge considered obsolete was put in shape to serve traffic for many years to come. It was as if the traffic load had been cut in half.

Many other examples of dead weight saved could be cited. Take dragline excavators. The excellent strength-to-weight ratio of aluminum will allow increases up to 20 per cent in length of boom or as much as 25 per cent in capacity of bucket. A 150-ft. all-steel boom that weighs 46,000 pounds fully rigged might, for instance, be replaced by an aluminum boom 175 feet long and weighing 29,000 pounds. That would mean increased working radius, less rehandling, equal mobility and stability. Also the counterweights could be lightened by some 25,000 pounds, making a total reduction of 42,000 pounds in the load carried on the rotating parts.

(Continued on advertising page 54)

The blonde is still platinum, but Union Pacific's high-speed trains are all-aluminum now. Light-weight aluminum partitions have largely replaced the familiar curtains

People with Hobbies Are Better Workers


ENTER YOUR HOBBY TODAY
JULY 18th to AUGUST 18th
WITH COMMITTEE ON ARRANGEMENTS
HOBBY SHOW of TOLEDO SCALE EMPLOYEES at TOLEDO MUSEUM OF ART
FIRST EXHIBITION OF ITS KIND EVER HELD

A THINKING mind is an alert mind, and an alert mind will always do better work. Toledo Scale executives probably had some such bit of practical philosophy as that in mind when they sponsored the Employees' Hobby Show.

Held July 26 to August 29 in the Toledo Museum of Art, it gave employees an excellent outlet for initiative, provided an opportunity to display talents which the management never suspected they had.

Arrangements for the show were made in a shipshape manner. There was a committee of twelve people representing various departments; a poster was done by employees and reproduced by the offset method in the chart department; news releases and photographs appeared in the daily papers; a catalog of entries was printed. The latter went to press on July 5 with 252 exhibits listed. Subsequently as many more were offered, had to be refused.

Employees and their families were eligible. The treasurer's bird house was there. So were the telephone operator's verses, the quilt made out of 275 neckties by a woman in the assembly room, a machinist's stuffed hawk, a stenographer's hand-painted china nut bowl, a draftsman's model of the Santa Maria, a clerk's collection of arrowheads, another clerk's hooked rug, a typist's flower garden quilt, the purchasing agent's wife's boudoir pillows, an assembler's pressed flowers, the patent attorney's photographs, a toolmaker's clock dial, an etcher's checkerboard, a painter's writing desk, somebody's stamp collection.

Those are samples. They give a rough idea of what the employees were doing with their spare time. Analysis showed that 20 per cent exhibited needlework; 14, cabinet work; another 14, art of one sort or another. Seven per cent raised pet animals; 6 played with photography; 6 indulged in outdoor sports; 4 collected coins or stamps; 4 were gardeners; 4 built models; 2 wrote poetry; 1½ composed music, practiced taxidermy.

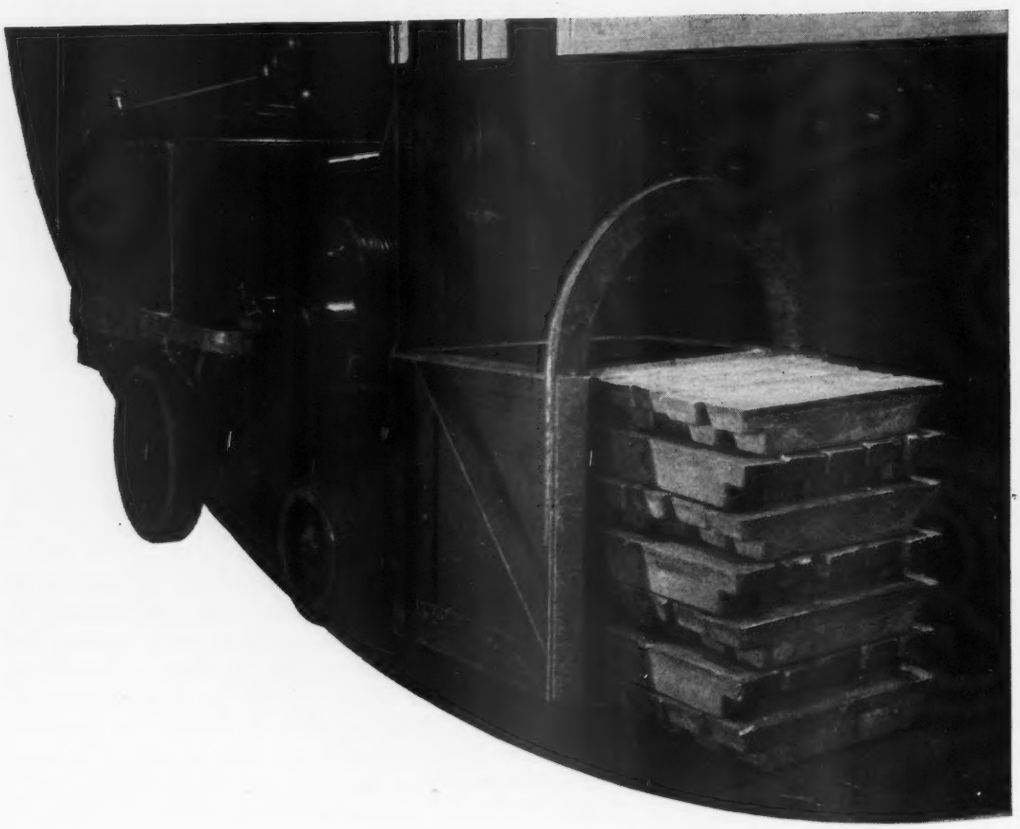
Another large group—some 13 per cent—was made up mostly of toolmakers who followed as a hobby the same type of work they do all day long. So there were several displays labeled planer gages, universal V-blocks, layout plates, parallel clamps, spring threading tools, angle plates, telescoping gages, sine bars.

It had long been a custom for men to stay after hours if they wanted to and use company machinery. No one, however, had ever guessed to what extent they were taking advantage of the privilege.

From the museum's standpoint the Toledo Scale Company's Hobby Show was so successful that it contemplates making it an annual event open hereafter to the general public. As for the company, it found the show was just one more way of developing the "contented family" feeling which it believes is so necessary to a closer employer-employee relationship. Any concern anxious to attain that same end might do well to add a hobby show to its present personnel program.

Equipping steel tiering bins with two angles on the bottom, to hold them on the rotating fork for dumping, made possible a simple and efficient method of handling scrap metal with an electric truck. The truck tiers the bins two high with the forks in the normal position. By reversing the forks it is possible to add a third layer

More Work from Tiering Trucks



A lifting box with two inward projecting flanges that slip under the lifting lugs of a stack of 35 lead pigs makes it practical to unload 500,000 pounds of lead with an electric truck in an eight-hour day

Photographs by courtesy of the Western Electric Company, Hawthorne Works, Chicago

Labor Costs in Advance by Formula

Procedure: Establish correct times on present product; determine relation between present and new products; derive and use formulas

Thomas L. Hapgood

Industrial Engineer, Strathmore Paper Company
Springfield, Mass.

THIS article deals only with the finding of direct labor costs. Admitting that these costs must be based on time, and time alone, it is of prime importance, in estimating costs on new or changed items, to arrive at correct time figures.

In this connection the value of proper time studies as a basis for cost findings should not be overlooked. Without true time estimates there can never be correct cost estimates, and therefore there cannot be correct determination of selling price.

Assume that we are to bring out a new product, different from but similar to a product now being made, and to be made on the same equipment that we are now using. Provided we have the correct times established on the present product, and know the true relation of the new product to the present one, we may, by various means, accurately determine the time required for the new item.

Assume further that we now make several items on the same equipment and that from time to time we shall add several new and similar items. By the derivation of simple algebraic formulas for the specific jobs in question, it becomes a simple matter to figure absolute times or costs from those engineering data that are always available with the development of a new job. Whether we are interested in time or piece prices, the same routine must be followed, for any piece price, to be correctly set, *must* be based on correct time.

In the following examples of formula derivation it is my plan to follow through the logical line of reasoning and then to substitute the algebraic symbols for this reasoning. Though the examples are the result of actual applications, probably they would not fit any other case. However, the logic behind the derivation can be applied, with necessary specific changes, to many other applications.

Example I

On a group of similar machines a product is made automatically. A single operator feeds raw coil stock and removes trays of finished work, there being several trays of finished work to each coil. By time studies it is determined that one man can run several machines, the number dependent upon the individual jobs in process. The piece prices will be set on man time plus fatigue allowance, and will pay 60 cents per man hour for 100 per cent man efficiency. (100 per cent man efficiency is the sensible interpretation of the speed which a fast man moving at his best *normal* speed can maintain throughout the working period). We also learn by time study the number of minutes required to handle a coil of material, and the number of minutes required to handle a tray of work, both quantities being standard 100 per cent times (including fatigue allowance). From the engineering data we know the number of pieces per coil and per tray for any given size piece. We wish to establish both standard times and piece prices for: First, each tray; second, each thousand pieces; third, each 100 feet, because this product eventually goes into an assembly that is sold by the foot. Let

A = handling time per tray
B = handling time per coil
M = number of trays of work per coil
Ft = number of feet per tray
Rc = machine running time per coil
Rt = machine running time per tray
RPM = revolutions per minute of the machine, each revolution giving 6 finished pieces
Pt = pieces per tray
S = standard man minutes per coil
P = pieces per foot
X = minutes or cents per tray
Y = minutes or cents per 1,000 pieces
Z = minutes or cents per 100 feet

(We can let minutes and cents be equal to each other, because we are paying at the rate of 60 cents per hour or 1 cent per minute).

To establish an equation for X (minutes or cents per tray), our line of reasoning is as follows: Standard man minutes per tray equals standard man minutes per coil divided by the number of trays per coil (1); standard man minutes per coil equals the number of trays per coil times the standard handling minutes per tray, plus the standard handling man minutes per coil (2); and the number of trays per coil equals the machine running minutes per coil divided by the machine running minutes per tray (3). These figures are computed for any

given piece from the engineering data available. It must be remembered that we are looking for man minutes and not machine minutes; and that the man minutes per coil will be less than the machine minutes because we are allowing the operator as a standard only his invested time, and not the total machine running time, for he is to invest his man time in other machines after getting the first one started.

Substituting algebraic symbols for the above reasoning we get:

$$(1) \qquad X = \frac{S}{M}$$

$$(2) \qquad S = (M \times A) + B$$

$$(3) \qquad M = \frac{Rc}{Rt}$$

Then, substituting (2) and (3) in (1), we get:

$$(4) \qquad X = \frac{(M \times A) + B}{M} = A + \frac{B}{\frac{Rc}{Rt}} = A + \frac{(B)(Rt)}{Rc}$$

The values of A and B, as already stated, have been determined and will not change; and the values of Rt and Rc are computed for each product from engineering data regarding pieces per coil and tray, and the r.p.m. of the machine in question from the machine record.

To establish a formula for Y, or minutes or cents per 1,000 pieces: Pieces per tray equals machine running time per tray times revolutions per minute times pieces per revolution (5), and we have assumed 6 pieces per revolution. Then, standard man minutes per tray (or X) divided by pieces per tray equals minutes per piece, and this figure times 1,000 equals the minutes or cents per 1,000 pieces (6). Writing these two facts algebraically, we get:

$$(5) \qquad Pt = (Rt)(RPM)(6), \text{ and}$$

$$(6) \qquad Y = 1{,}000\frac{(X)}{Pt}$$

Substituting (5) in (6), we get:

$$(7) \qquad Y = \frac{1{,}000(X)}{(Rt)(RPM)(6)} = \frac{(166.7)(X)}{(Rt)(RPM)}$$

Substituting value of X from (4),

$$Y = \frac{(166.7)}{(Rt)(RPM)}\left[A + \frac{(B)(Rt)}{(Rc)}\right]$$

$$= \frac{(166.7)(A)(Rc) + (166.7)(B)(Rt)}{(Rt)(RPM)(Rc)}$$

Since A and B are constants, the values $166.7 \times A$ and $166.7 \times B$ will show as constants when A and B are substituted.

To find Z, or minutes or cents per 100 feet, we must first know the pieces per foot, which we get from our engineering data. We also reason that feet per tray equals pieces per tray divided by pieces per foot (8). As already established, the pieces per tray is:

$$(5) \qquad Pt = (Rt)(RPM)(6), \text{ so:}$$

$$(8) \qquad Ft = \frac{(Rt)(RPM)(6)}{P}$$

Our reasoning also shows us that minutes per tray divided by feet per tray times 100 equals minutes per 100 feet (9). So, algebraically we may set down:

$$(9) \qquad Z = \frac{(100)(X)}{Ft}; \text{ and, substituting for } Ft \text{ and then for } X \text{ we get:}$$

$$(10) \qquad Z = \frac{(100)(X)}{\frac{(Rt)(RPM)(6)}{P}} = \frac{(100)(P)(X)}{(Rt)(RPM)(6)} = (100)(P)\frac{A + \frac{(B)(Rt)}{Rc}}{(Rt)(RPM)(6)}$$

$$= (16.7)(P)\frac{A + \frac{(B)(Rt)}{Rc}}{(Rt)(RPM)}$$

If we have already determined the value of X we can substitute this in the equation, and get:

$$(11) \qquad Z = \frac{(16.7)(P)(X)}{(Rt)(RPM)}$$

Now all that is needed to find the actual cost of the direct labor on the job, as long as it may run, is to substitute the variables, which we get from our engineering data, in the equations. This will also give us the man time that will be expended, and from that we may estimate accurately the overhead expected on the job.

Example II

There are three groups of machines, run by one operator, but the volume of work controls the proportionate amount of each group the man will run. From actual time study it is found that for 100 per cent man efficiency one man will run 18 machines of Group I at 85 per cent machine efficiency, 7 machines of Group II at 82½ per cent machine efficiency, or 6 machines of Group III at 80 per cent machine efficiency. The machines of Group I are to pay the man for 100 per cent man efficiency 60 cents per man hour; Group II, 57 cents per man hour; and Group III, 45 cents per man hour. Business is such that a man must run some machines of each group in order to keep himself occupied. We must, therefore, set up a general formula covering all groups. Again, the product is sold by feet, and we wish to determine a labor cost per 100 feet.

We reason as follows: If we divide the rate per machine hour (which will be the rate per man hour divided by the number of machines the man will run for 100 per cent efficiency, and different in each of the three groups (13) (15) (17) by the r.p.m. times 60 (which gives the revolutions per hour and at one piece per revolution the pieces per hour) times the expected

(Continued on advertising page 64)

Allan H. Mogensen
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Motion Study, Mr. Safety Man, *Makes Any Plant Safer*

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"From time to time I have had an opportunity to observe the effect of these time study or wage incentive systems, and I feel that any attempt to speed up the worker is certain to increase the accident rate."

This company has throughout its plants one of the finest safety records in the country. I could see he was worried. And, as his fears were not unfounded, it seemed best to start at the beginning.

"In the first place," I said, "motion study is NOT a speeding-up process. Distinction must be made between work done *at high speed,* and work done *in a hurry.* High speed will give perfect work, because the speed is made by eliminating unnecessary motions. Work done in a hurry is often poor work, because it is a speeding-up of all motions, both necessary and unnecessary.

"Any plan, therefore, which requires the operator to perform a task in less time than that taken formerly without showing him how to eliminate useless and wasteful motions *is* likely to require some speeding-up. I'll grant you that the operator is then likely to hurry, and an accident may result.

"Motion study, on the contrary, seeks to find the best way of doing a job, and, surprising as it may seem, the best way is usually the easiest way. Now I don't know your definition of safety, but mine has always been *the right way of doing a job.* An accident is always the result of something done the wrong way. Am I right?"

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1. Elimination of Travel and Handling

"A great many accidents occur as a result of falls, handling objects, stepping on or starting objects, operating vehicles—"

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"Later on, as the operators become motion-minded, you will see very little of the walking and handling you see now. Containers will be placed right at the point of use, not across the aisle or on a bench. Wherever justified, we shall use mechanical handling to replace the present lifting and carrying. With conveyors it is often possible to run work through a whole series of operations without any handling at all. Every handling eliminated is one less hazard."

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plifying the remainder, this travel could be reduced to a little over 5 miles.

2. Reduction in Number of Motions

"Now your table there shows that 11.7 per cent of the accidents occur in operating machinery and 7.5 in using hand tools. As we progress in motion economy work, we devote considerable time to the study of the actual right- and left-hand motions used. Here training becomes a big factor in making every job a safer one. I am going to list under item 2 above:

"A. Machine Operations—

"We have gone a long way in providing mechanical safeguards for machines, but these safeguards are often rendered inoperative by the worker, who finds they interfere with his production.

"Our foremen will come to appreciate the value of replacing many of our hand controls with foot-operated devices, or of installing automatic cycle control. Thus both hands are freed for more productive work.

"Every job is made up of three parts—MAKE READY, DO, and PUT AWAY. First we try to eliminate as much of the MAKE READY and PUT AWAY as possible. If they cannot be eliminated, we try to arrange the operation so that the MAKE READY and PUT AWAY can be done *during* the time that the machine is operating. All these things increase effectiveness without speeding-up the operator.

"Take the familiar air hose for blowing out chips from fixtures and dies. It is usually hung so that the operator must reach to use it, often moving into a danger zone to do so. If we design our fixtures and dies so that air is directed at the proper point, operated either by a foot-valve or automatically, we save time, eliminate fatigue—"

"And make a safer operation," he supplied. "Also, an air hose in the hands of the practical joker is a dangerous weapon. I've always hated to see one around."

"Consider fatigue," I continued. "Motion study means improving rhythm. Motions are usually relaxed motions, and involve less movement of the body itself. You know that a tired worker is more liable to accidents."

"Yes," the director said, "investigations show that accidents tend to increase with each successive hour of work in the morning, reaching a maximum at approximately 11 a.m., then falling off. The number and rate rise again sharply following the noon hour, reaching a peak toward the latter part of the afternoon, but dropping off somewhat during the last hour of work. If your motion study is going to help to eliminate fatigue, we won't have any fight there."

"That brings us to the second item," I said, putting down:

"B. Hand Motions—

"Now, while we can safeguard machines, hand tools, as the table shows, account for a considerable number of accidents, and are not so easy to guard. We try to lay out each workplace so that definite fixed stations for tools and supplies may be maintained. This builds up automaticity of movement which replaces conscious mental direction, so that less effort is required and a better rhythm cultivated."

"But isn't that likely to result in an accident?" asked the director. "The operator may allow his attention to wander, instead of being on the alert."

"I don't think so. Take a punch press with a single-cavity die. The operator places and removes the material with the right hand, operates the lever with the left. This is likely to be dangerous, even with guards. So the safety engineer equips the machine with two levers; after the material is placed in the die each hand goes to a lever to trip the press. Soon you may find one of these levers blocked up, or the operator using an elbow to hold the lever and feeding the material in with the hand.

"Now suppose we apply a little motion economy. With a double-cavity die we locate the material on both sides, so that it may be secured with less effort. We locate the hand controls convenient to the material bins, more than doubling possible production. We make the operator safer, because we can set a standard that permits him to work with less haste. His motions are definite and exact. Instead of getting careless, he builds up a habit of motions that is hard to break. If anything goes wrong, he will stop first because he must think before he moves. Now in our first set-up, with one hand idle, it is usually the idle hand that darts in to straighten or remove the part—"

"And often gets caught in the act," said the safety man.

Just Plain Mathematics

"Just so. And," I added, "if you consider the mathematics of the thing alone, you have only half as many strokes of the press in doing a given number of pieces, so only half the possible chances of injury.

"I found a fine example of the close tie-in between motion economy and safety in one plant where we had even had a course for maintenance men. It seems that in oiling a large group of machines the oilers had been reaching inside the guard, slowing down the idler pulley, and giving the grease cup a few turns. One day the safety engineer saw a man do this, gave the order that the machines *must* be shut down. I don't blame him a bit, for it might easily have cost an arm. Well, one oiler grumbled to his foreman. He had to hunt up the department foreman, get permission to shut the whole line-shaft down, throw out all the clutches, shut down the motor, and then after greasing the pulleys, reverse the process. All this involved a lot of walking and wasted too much time.

" 'Find a better way, then,' his foreman replied.

"He did. I saw his suggestion in operation the other day. He borrowed an idea from the automobile designer, had the pulley shaft drilled and a fitting centered on the end of each shaft, and now he goes through the department with a large grease gun—"

"Saves a lot of time, I suppose."

I caught the trace of sarcasm, but let it pass.

"The big saving is not in the maintenance man's time, but in idle machine time and improved quality of product. It's a 24-hour operation, you know.

"Now," I went on, just warming to my subject, "let's consider motion economy and fire protection."

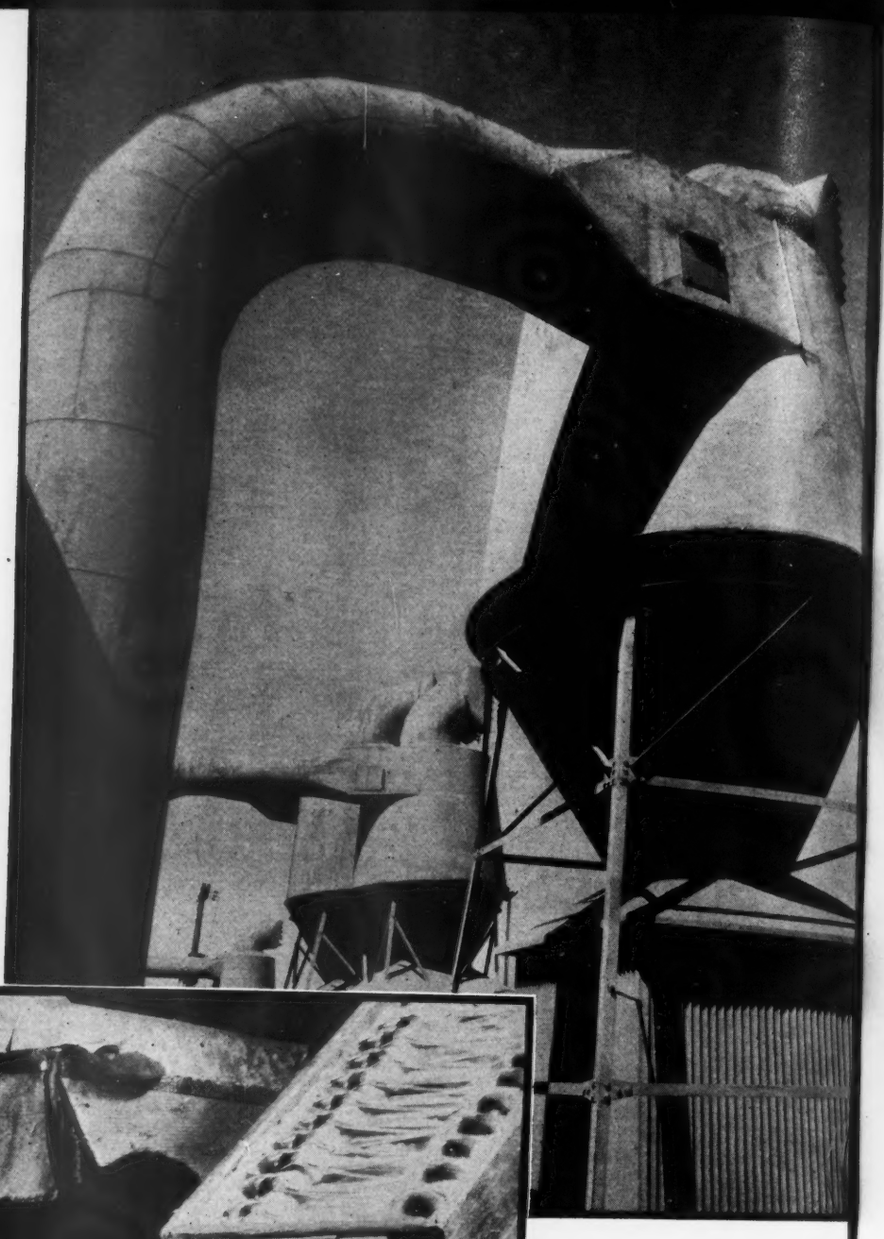
"I'm afraid we'll have to put that off till next time. I've got an appointment with the works manager. And I'm going to tell him that I won't have to worry about this plant so far as safety is concerned."

40 Foot-Candles

. . . isn't a bit too much for fine work like printing or assembling galvanometers. One look at the detail in the upper photograph (some of it is necessarily lost in the halftone reproduction) is enough to prove that the lighting in this particular pressroom will more than pass muster. In the electrical instrument plant (below) Glassteel Diffusers supply the high lighting level and the easy, comfortable seeing required for the assembly of small precision parts. Centers are 7 by 8 feet; lamps, 300 watts. Light-colored walls and ceilings reduce shadows, relieve brightness contrasts in this room. It's looking from bright to shaded areas and back again that causes much of the eyestrain in industry, with its attendant headaches, lowered production, and increased spoilage

▼

DUST Is Out



Photographs by Rittase

THERE'S nothing like a "change of air." Two hundred silverware workers in the black (before plating) buffing room at Oneida Community, Ltd., Sherrill, N. Y., get it every five minutes. Oneida officials learned long ago to their continued profit that factory ventilation is a fundamental of good plant design, not something that management puts off until labor laws apply the necessary screws. Hence a buffing room that is not just a *decent* place, but a *good* place, to work in. Fans are located under the floor. All piping is beneath benches. Not only was it cheaper to do the job that way, but distinctly better from the lighting standpoint. Since the rate of change is so high, the room would get air bound if fresh air were not introduced from outside. This is done through heaters located on the ceiling. Tempered when necessary, this flow of air creates a low, even velocity around the men at the buffing wheels. No drafts, no dust, plenty of the fresh air that is so essential if the health of industrial workers is to be preserved. Lowered vitality will inevitably lead to lowered production; savings made by providing good ventilation may easily add up to more than the cost of providing it.

"Management and Labor Are in the Same Business"

A statement of General Motors Corporation's basic policies governing its relations with factory employees

I—Introduction

THE MANAGEMENT of General Motors holds that there is no real conflict of interests between employers and employees . . . is conscious of the fact that it cannot get along without labor any more than labor can get along without management. Both are in the same business and the success of that business is vital to all concerned.

In the establishment and maintenance of an effective working relationship between management and employees under which the rights and interests of each may be mutually understood and kept in equitable adjustment, employee representation for purposes of collective bargaining may have an important place . . .

II—Scope of Collective Bargaining as Applying in General Motors

Collective bargaining is to be understood as a method of intercommunication and negotiation between employees and management whose objective is the maintenance of harmonious and cooperative relations through mutual understanding and agreement with respect to terms and conditions of employment. It may be practiced informally as well as formally. But when there are specific and generally understood provisions for the handling of all matters coming within its scope, and when there is a clearly defined management policy with respect to relations with employees, the groundwork will have been established for fostering mutual understanding and cooperation.

It is important in the beginning to define as exactly as possible the limits within which management can agree to compose differences with employees, and beyond which it cannot go without surrendering its responsibility.

Management should recognize the importance of social considerations as influencing broad policies governing industrial relations. For example, if medical research discovers that certain conditions of employment are inimical to the health of the employees, management should take such action as is practical to remedy the harmful conditions.

On the other hand, management has certain inherent responsibilities and duties which must also be recognized.

The fact that management subscribes to the principles of collective bargaining in no way absolves management of such inherent duties, nor has management the right to relinquish such responsibilities. It must be made clear that collective bargaining does not imply the assumption by the employee of a voice in those affairs of management which management, by its very nature, must ultimately decide upon its own responsibility. It does not mean collective employer-employee management and must be limited to employer-employee relationships.

Management is charged with the responsibility for promoting and maintaining the best long-term interests of the business as a continuing institution. Therefore, while management should exhaust every means in endeavoring to settle all problems of employer-employee relations which may arise, it cannot agree to submit to arbitration (which is a surrender by both sides to the authority of an outside agency) any point at issue where compromise might injure the long-term interests of the business and therefore, in turn, damage the mass of employees themselves.

This does not in any way mean that impartial or judicial agencies have no place in collective bargaining. On the contrary, controversial questions of *fact*, such as discrimination cases and questions of lay-off, may frequently be more amicably and speedily settled through an impartial, competent, fact-finding agency having the confidence of both sides.

III—Collective Bargaining Procedure

Under the terms of Section 7A of the National Industrial Recovery Act, to which General Motors has subscribed, there is the requirement to bargain with employees collectively through representatives of their own choosing, if employees so desire. Membership in a labor union or other type of labor or employee organization does not in itself establish the right of any such union or other organization to represent employees in collective bargaining negotiations. Representatives for such purpose must have been specifically chosen by the employees they are to represent and the fact of such choice must be established.

While there is the technical requirement that in collective bargaining negotiations the right to represent employees must be duly established, nevertheless the management should be reasonable in its willingness to listen to anyone desiring to discuss matters purporting to affect General Motors employees.

A. Understandings Resulting from Negotiations. In the event that an issue is raised by a particular group or their duly accredited representatives, the settlement of which involves the interests of non-represented groups, the management should satisfy itself that any decision arrived at provides fair treatment with respect to such non-represented groups.

B. Procedure with Bargaining Groups.

1. *Questions Not Requiring Formal Conference.* The procedure outlined in this sub-section does not contemplate formal conferences between management and employees or their representatives, but rather the ordinary managerial consideration and attention to views and contentions indicated in behalf of employees. Questions raised by employees, or by accredited representatives, should be dealt with as expeditiously as practicable at all times. Routine matters falling within the scope of authority of the foreman or the supervisory executive in immediate contact, should be settled on the spot whenever it is possible to arrive at a satisfactory understanding. When the matter is outside of the scope of the authority of the foreman or the supervisory executive in immediate contact, or if a satisfactory settlement cannot be made by him, the foreman or the executive should in all cases submit the matter to his superior. Similarly, if the matter is outside of the scope of authority of the executive to whom it has been submitted, or if he cannot settle it satisfactorily, he, in turn, should submit it to his superior and successively the matter should be referred up through the organization until it reaches the executive whose scope of authority enables him to make final decision. Every effort should be made

Extracts from the revision of August 6, 1934.

to effect an amicable settlement, even if this necessitates referring the matter all the way up to the General Manager of the Division. When a matter has been decided, not only the exact nature of the decision, but also the management's viewpoint thereon, should be made clear to those down the line to the point of initial contact with the matter.

2. *Questions Requiring Formal Conference.* In all matters which cannot be settled informally and with mutual understanding, and which justify conference to reconcile opposing viewpoints, it is necessary to give practical consideration to the requirements of the case. With the general duties and responsibilities resting upon the supervisory executives, it is impracticable for them to hold themselves in readiness for conference with employees or their representatives at any time the occasion might present itself. Each Division should establish a definite plan providing that a conference will be held within five days from the receipt of written notice setting forth the purpose for which conference is desired.

3. *Records of Meetings for Purposes of Collective Bargaining.* Each Division shall keep an adequate record of all meetings with properly accredited representatives of its employees, inciuding the terms of understandings entered into by the management, so as to minimize any conflict of interpretations.

In order that the Corporation may be fully informed with respect to the manner in which the collective bargaining efforts of each Division are proceeding, each Division shall report through its Group Executive to the Executive Vice-President all cases which have been raised and as to which the Division Management has been unable to reach a satisfactory settlement with employees or their representatives within two weeks from date of inception. In submitting such reports, the Division should include complete details of the cases involved.

4. *Appeal Procedure for Employees or Employee Representatives.* In any case where it has not been possible to arrive at an amicable understanding through conference and discussion —even after the case has been referred to the General Manager of the Division—employees or their representatives may refer the case to the Department of Industrial Relations in Detroit. In such cases a complete statement of the facts, together with supporting evidence, should be submitted by both sides of the controversy.

The Department of Industrial Relations will review the material submitted and make such independent investigations as may be necessary to determine if there has been either a violation of company policies or if the case involves matter beyond the scope of divisional authority. If it is found that the case falls within either of the above two categories, the complete facts will be referred to the Executive Vice-President through the group executive for such action as may be required.

5. *Subjects for Discussion.* Under the conditions outlined herein, the management of each Division will provide means whereby any question subject to collective bargaining raised by employees may be discussed and endeavor made to reach a satisfactory settlement thereof.

It must be distinctly understood that it is contrary to the letter and the spirit of collective bargaining for the management to attempt by any means to prevent questions as regards same from being raised by the employees and fully discussed with them or their representatives.

C. Relations with Employee Collective Bargaining Organizations. *Employees must be given entire freedom with respect to the selection and form and rules of their organization and their selection of representatives.*

This principle does not preclude the management from assisting or advising any employee organization in the development or carrying out of plans for the employees' mutual benefit, provided that in the determination of the right of employees to participate in any benefits resulting from such activities there be no discrimination by management on the ground of affiliation or non-affiliation with any employee or labor organization.

D. Solicitation of Membership in Employee Organizations for Collective Bargaining. *The President's Automobile Settlement states: "The Government makes it clear that it favors no particular union or particular form of employee organization or representation. The Government's only duty is to secure absolute and uninfluenced freedom of choice without coercion, restraint, or intimidation from any source."*

Since this provision bans coercion by unions as well as employers, all cases of attempted coercion by outside unions to force employees to join them should be thoroughly investigated and if they can be substantiated, referred through the lines of organization to the Industrial Relations Department in Detroit for their records and such use as may be found desirable.

Although the fact that employees are members of an employee association or of an outside union does not make such association or union the agent of these employees for collective bargaining purposes, the Automobile Labor Board has laid down a general ruling that there should be no solicitation of membership during working hours. This rule applies to both employee associations and outside labor organizations and must be enforced impartially. Lax enforcement by the management of this rule as applied to solicitation for membership in employee associations organized for collective bargaining, and rigid enforcement as applied to cases of solicitation by "outside" unions, is evidence of discrimination and is illegal.

IV—Increasing and Reducing Labor Forces

The law is explicit in its provision that no one seeking employment shall be required as a condition of employment to join any employees' association or to refrain from joining, organizing or assisting a labor organization of his own choosing.

It is important that all Employment Departments make every effort to hire local employees. Only after all satisfactory available local applicants have been hired should employment be given applicants from other communities. However, when the importation of employees for limited periods of seasonal or other peak employment could be avoided if the existing labor force were permitted to work during such periods, more than the maximum number of hours specified by the code under which the Division is operating, the Division should apply to the NRA—through the proper Central Office Executive—for the necessary exceptions to permit its existing working force to work longer hours, so as to avoid the economic and social consequences which result from the importation of employees for brief periods of employment. *No departure from code requirements is to be countenanced, however, without specific approval of the Executive Committee through the Executive Vice-President.*

In the lay-off and re-hiring of employees, divisional management will be governed by rules laid down by the Automobile Labor Board and such interpretation or explanation of these rules as may be issued from time to time by the Department of Industrial Relations.

V—Discharge of Employees

The management has the full right to discharge an employee for cause, such as, for example, insubordination, inefficiency, or infraction of shop rules. The decision to discharge an employee, however, must rest upon clear and explicit cause and must be reasonable. Furthermore, the full reasons for discharge should be recorded and should be stated explicitly to the employee.

The law is explicit in its prohibition of discharging employees for affiliation or non-affiliation with any labor or employee organization or for joining, organizing, or assisting a labor organization of their own choosing.

The prohibition against discrimination places an additional responsibility upon the management to furnish clear evidence of the justification of the discharge of any employee in the event that discrimination is alleged.

It is one of the most immediate and vital responsibilities of the management of each Division to make these points clear to everyone in its supervisory organization, and the management must be held accountable in any case where discrimination is clearly apparent.

VI—Informing Separated Employees of Their Status

When a man is separated from any Division he should be given a release slip, clearly indicating the reasons. If he is discharged, he should know why; if laid off on account of reduction in force, it must be understood he is eligible for re-employment. When a man quits, his release slip should indicate this. The slip and the employment record should give the employee's status in plain English, not in code.

The foreman should be thoroughly familiar with all the facts.

MANAGEMENT SHORTS

No Danger of Getting Crowned

HAROLD L. NASH
Personnel and Safety Manager
Nash Engineering Company, South Norwalk, Conn.

Contrary to the perhaps justified generality that most safety appliances tend to slow up the operation of a machine, it sometimes works out that a guard installed purely as a safety measure will result in increased efficiency and ease of operation. This proved to be the case when guards were applied to the large feed wheels on a bank of multiple drill-presses.

The spokes of the wheel shown in the accompanying photograph, as originally built, protruded with no protection. Last year a workman received a severe laceration on the head while inspecting some castings at the side of the machine. The operator, after completing a drilling operation, gave the wheel a whirl to raise the drills. The wheel was going with considerable force when the end of a spoke hit the man and cut his head badly.

Analysis of this accident showed that it could not have happened if the wheel had been equipped with a rim. The operator objected at first to having one applied, claiming that it would slow up the operation. He stated that in using the wheel he slipped his hand over the end of the spokes, which, of course, he could not do with a rimmed wheel.

It was decided, however, to put a rim on one of the machines and try it out. A steel pipe was bent to fit the spokes and welded to them. After using the revised wheel long enough to get used to it, the operator admitted not only that it was not a handicap, as he had anticipated, but that he could use the rim to advantage and that he preferred it to the old one.

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Why Clean at All?

W. J. BROSNAN, Worcester, Mass.

Confronted with an enormous cleaning problem on a volume stamping job recently, someone said, "Why clean at all?"

After considerable experimenting a combination of gasoline and mineral oil in just the right mixture used in conjunction with finely honed tools was found to make the stock go through the tools successfully and reach final inspection actually cleaner than could have been hoped for even with washing.

The film of gasoline and oil put on the metal to start with was so fine that ordinary oilers would not work. A simple solution was to take a piece of lintless cloth and fold it thick enough to bear on the stock and then put just enough oily mixture on the top of the cloth each time a new coil was fed into the machine. A little practice soon resulted in the work starting with just enough lubricant, going through the process clean, and ending up with almost the equivalent of a hand-rubbing operation because of the many intermediate handlings where no lubricant was used.

Because the job was a clean one where such jobs are ordinarily messy, operators liked it and production increased. Through the influence of the clean job complaints about dirty ones caused changes resulting in a cleaner, pleasanter shop and big savings in use of lubricant and cost of cleaning.

Air enters the drying chamber in Sharp & Dohme's pill and tablet department at 170 deg. F., leaves at 140, was formerly vented, is now led through an intervening department and used all over again to dry the same pills and tablets after coating.

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One concern on our calling list has installed showcases in the shop. In them are displayed new products in the line, the idea being that many of the employees never see the finished article, ought to see it if they are to be expected to do their best work.

•

Because three accidents didn't quite come off, a New Jersey concern saved $22,880 in the brief space of two days. Goggles saved both eyes of one employee, aged 27, life expectancy 62, compensation $19,400. Another man, age 31, who would have lost one eye, rated $1,880. Third, also 31, one eye, $1,600.

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Employees of C. F. Burgess Laboratories have been keeping diaries since 1910. Says Dr. Burgess: "An employee whose daily work does not uncover something of interest to himself and his company which is worthy of writing about should look for another job."

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Soldering in one of the silver plants is done behind glass. Spatters on the panes show what might have been.

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Gum drops and saline tablets, 500 pounds a month, helped 3,600 Allegheny Steel workers keep going in the hot weather of July and August. Gum drops supply glucose and saline tablets salt, both lost through perspiration.

•

It was hot in Milwaukee, and nowhere hotter than on the second and top floor of the Jambor Tool & Stamping Company—until the general manager laid a perforated pipe along the roof and turned on the water.

•

Variations in steam pressure made it impossible, even with thermostatic control to keep a special testing room at the Brunswick-Balke-Collender Company, Muskegon, Mich., within one degree of the 100 degrees necessary. An electric heater and fan, replacing the steam coil and fan installation, uses the same thermostat, has no trouble keeping the room within the close limits specified.

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You want to know

and the editors will be glad to tell you . . . . .
more about the things mentioned on this page

• TUFFERNELL is the euphonious name given a new wire used for windings of electric motors. Enameled, coated with adhesive, spiral-wrapped with flexible paper, it's stronger, tougher than you know what.

• DOUBLE GLAZED windows stop heat losses, use two panes with dehydrated air sealed in. For air-conditioning jobs, of course.

• PEOPLE who insist of using cork stoppers will delight in an easy-on-easy-off, molded-top cork designed to prevent shearing off.

• HYDRAULIC PRESSURE, according to a die-caster who is using this new method, provides greater tensile strength in aluminum, brass, or bronze castings with thin walls.

• SMALLEST CAMERA, British made, measures 2½ by 1¼ by 1 inch, takes pictures 18 by 13 mm., sells for 5 shillings.

• SPLIT-SECOND electric stop clock makes precision timing easy in laboratory, on experimental work.

• REVOLUTIONARY method of making belts endless is said to overcome the tendency for outside seams to open up during severe service.

• AIR PRESSURE supervisor gives automatic warning when pressure in "dry" sprinkler systems gets dangerously low.

• PACKAGES of tacks have been tipping over for years and years. Now comes a new flat pack, tip-proof, with tacks easy to get at.

• VISIBLE ATLAS now available operates like any visible index system.

• TRADITION is shattered by manufacturer who no longer rolls rugs on poles, packages them instead in neat cartons.

• SPECIAL grid bottom of aluminum can allows salad oil to circulate, keeps tuna fish in A-1 condition.

• NEW cotton gauze bandage is impregnated with a sterile "stickum" which makes it stick only to itself and hold without fastening. Won't adhere to skin or wound, not affected by alcohol or water.

• HEAT-REFLECTING aluminum foil is now being used to protect steel tanks and keep oil cool. Losses through evaporation justify the expense.

• ONE GOOD REASON for molded plastic jars is the low thermal conductivity of the material. Cold creams, for instance, are said to keep better in them during heat spells.

• GEARED fireless locomotive for industrial switching work has no boiler, no firebox, carries instead a tank of water heated by steam from a stationary boiler, does half a day's work on a single charge.

• FOR THE LAB, a new microscope with molded plastic base. Lighter, of course, and no enameling to wear off.

• BEST-LOOKING container of the month is the molded plastic box with fluted sides which a well-known silverware concern hopes will help sell more silver plate.

• STROBOSCOPIC STUDIES were recently made by a rayon concern to observe speeds and individual action of spindles, all with a view to improving quality of product.

• CONTINUOUS BLUEPRINTING, washing, and drying unit produces prints at rate of 12 feet a minute.

• MAGNESIUM alloy used in place of cast iron and steel for body parts reduces weight of a coal drill to such an extent that it can be operated by one man.

• CARTON with aluminum foil tight wrapper keeps moisture in, preserves quality of product—which happens to be prunes this time.

• KNURLED socket head cap screws cost no more than smooth heads, shorten driving time.

• NEWEST PHOTO-CELL application, perhaps, is in candling eggs automatically. Machine candles 30 eggs a minute, grades them more accurately, packs them in 1-doz. cartons.

• MOST UNUSUAL, but far from the worst, re-use container of the month is glassine-wrapped green glass pitcher packed full of cookies.

• PERMANENTLY CURED to the wheels is what the manufacturers claim for the treads on their new line of rubber-tired wheels for industrial trucks.

• INSULATING BRICK, new, is said by its sponsors to be capable of cutting fuel costs as much as 50 per cent.

• HOT MATERIAL belt, recently announced, is built to offer far greater resistance to abrasion even after long exposure to heat.

• PORTABLE ventilator, specially designed to remove welding fumes, can be bought.

• OSCILLATOR, recently developed for use on cement block machines, gives cement blocks a troweled surface.

Every factory has its office, every office its business machines, every machine its operator who stops every now and then to peer at her papers. This flexible lighting bracket supplies supplementary localized light on the working area, provides a shelf for papers which enables the operator to assume a more comfortable posture

Factory Management *and* Maintenance

A consolidation of *Factory and Industrial Management* and *Maintenance Engineering*

L. C. MORROW, Editor

SEPTEMBER, 1934

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Strikes And the Unemployed

THE LABOR situation in the existing period of upturn seems to hold no unusually explosive elements among employed men. Naturally, the issue of union recognition is being pressed, but it has not won the general sympathy either of workmen or the public, because of tactical errors such as the Kohler, Wis., fiasco and the San Francisco general strike. The important thing to most workmen is having a steady job.

Despite their aversion to jeopardizing their jobs, workers have been led to do so, and recent strikes have shown an ugly tendency to get out of hand and end in violence and bloodshed. Well-informed students of labor disturbances note the increasing organized participation of the unemployed in such violence. The presence of this group is a serious element in the present situation.

There are millions of people on relief. Many of them feel that they are forgotten men, for whom there is no longer any place in the world they used to know. At every turn the normal human needs for self-respect and security are repressed and driven back into bitterness. These men are idle, for the most part, in spite of such expedients as the C.C.C. Idleness can reach a point where violence is a welcome alternative to futility. Under such circumstances, revolutionary doctrine serves merely to make irresistible human impulses seem rational.

When a spark may ignite a tinder-dry forest, causing much senseless destruction, careful men do not drop matches. There is no call in the present situation for supineness in the face of aggression, but wise men on both labor and management sides will do well to submit their grievances to disinterested criticism, to find out how they look to the other fellow, before plunging into labor war. Should the situation get out of bounds and into the hands of these hapless outside trouble-makers, it will be well to put pity before anger and deal with the situation as with an epidemic, rather than a private quarrel.

Only when the employable population as a whole is again at work will this serious danger subside. Many federal projects, which could hardly justify themselves on ordinary grounds, become intelligible when the responsibility of the government for this phase of the national situation is fully realized.

Conditions are improving but meanwhile it will take time to put the unemployed back to work. The individual employer, and the labor leader, cannot forget that they, too, carry a considerable public responsibility.

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Individualism Still a Requisite

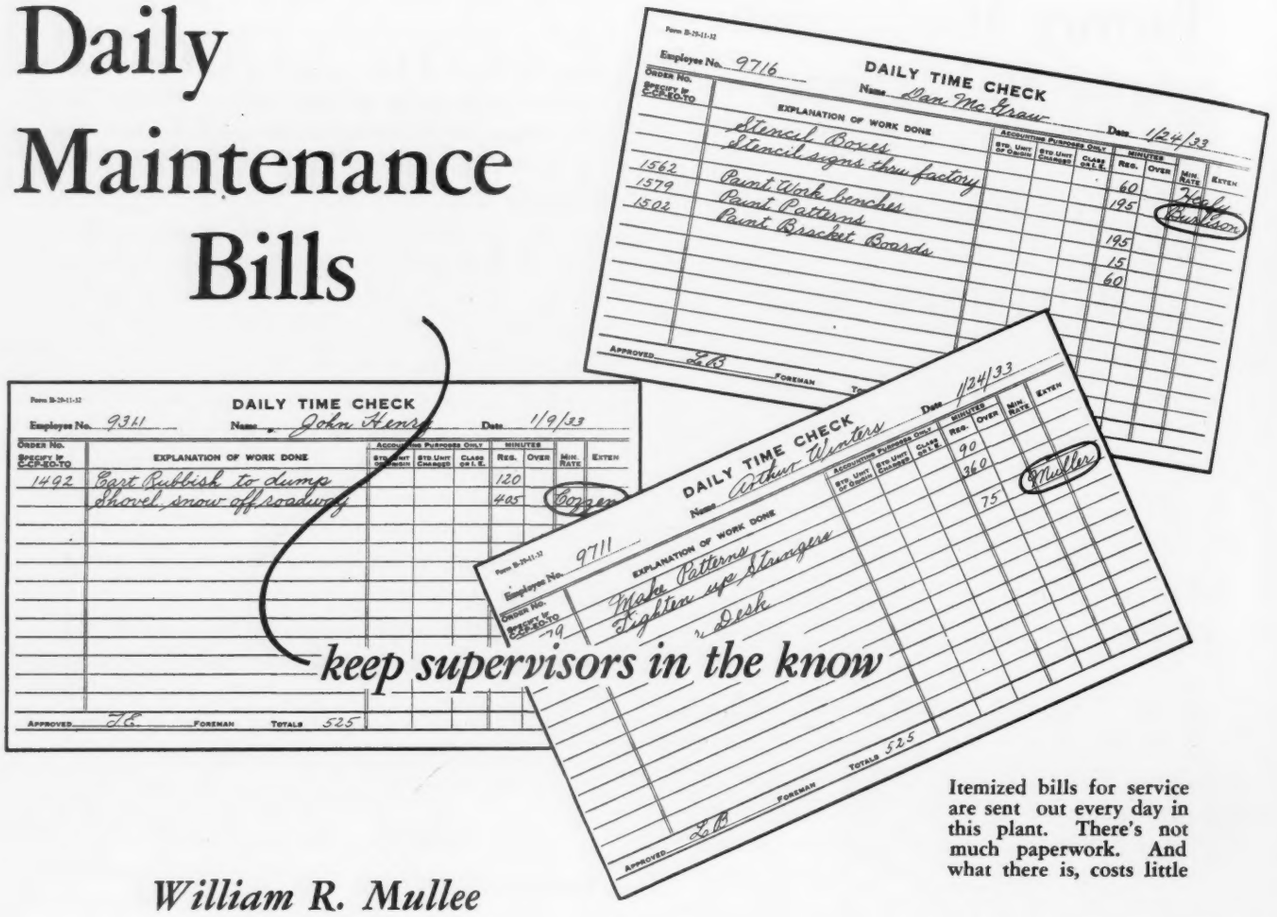
INDIVIDUALISM, rugged or otherwise, is not dead. It continues to be a requisite for success in industry, codes or no codes.

One of the manufacturers of our acquaintance, operating on less than $200,000 capital, was employing less than 40 people in March, 1933, was in the hands of a creditors' committee, appeared to be on the brink of disaster. Today he is keeping 200 men busy, running part of his factory day and night, can't keep up with the demand, and is making a nice profit.

What this manufacturer did is easy to tell, but required a considerable amount of doing. He developed a new style line during the dark days of 1933. It made a hit. A new branch plant was opened. Sales in every line were aggressively pushed—and responded.

If the pessimists and alarmists had been right, his business should be dead and buried. He might have let it go and blamed his difficulties on a code, on a code authority, or on recovery legislation in general. Instead, he recognized that the old requisite of individual enterprise is still in effect.

Daily Maintenance Bills



Itemized bills for service are sent out every day in this plant. There's not much paperwork. And what there is, costs little

William R. Mullee

American Hard Rubber Company
Butler, N. J.

EACH of our supervisors receives a weekly control analysis of his department's operating expense. He knows the details of items originating in his department. He knows some but not all of the items originating outside but charged to his department.

Some of the major items of expense originating outside come from the maintenance department. Because of the immense variety of maintenance jobs, it is not practical to describe and itemize each one on the control analysis. Whenever maintenance items were higher than usual, the plant accountant used to get a deluge of requests for detailed analyses. And then after the supervisor found out what caused the increase, not much could be done with this historical material except to cuss the maintenance department for putting two men on a one-man job, packing a valve twice, or spending half a day patching up a few worn-out belts.

We felt, therefore, that a daily "bill" for service rendered would induce better control than dumping the total amount in the supervisors' laps once a week.

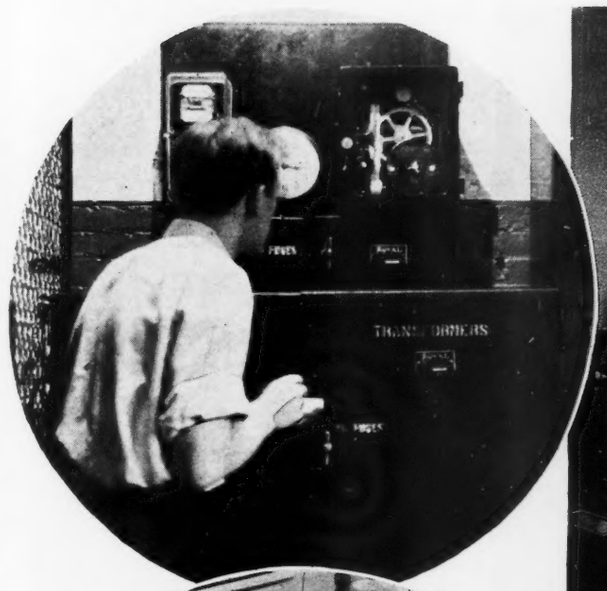
A number of plans were tried out until we found a good one. A carbon copy is now made of each daily time sheet for mechanics, painters, plumbers, and other maintenance men. Opposite each item is marked the name of the supervisor of the department to be charged. When the daily time sheet is dropped in the mail box, the carbon is dropped in also. The office boy making his rounds delivers the carbon to the first name on the list. After the supervisor has read over his "bills," he crosses out his own name and the "bills" pass on to the next man. Questions are taken up with the master mechanic within twenty-four hours.

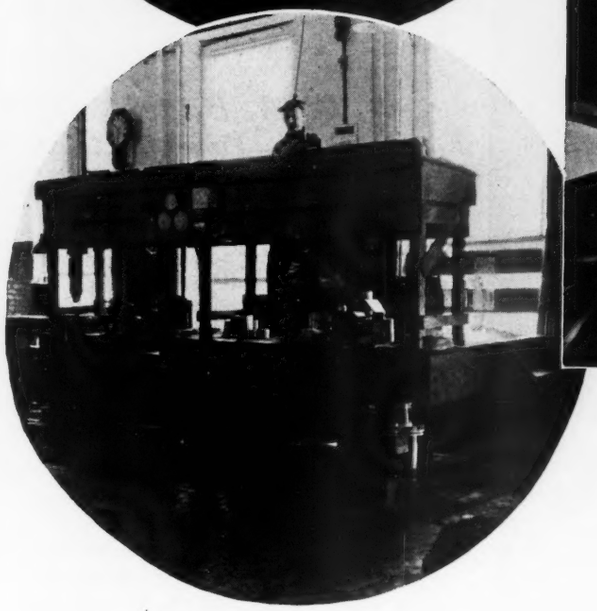
News, Not History

We wanted a system that would involve little clerical work and wanted to furnish *news* rather than *history*. The effect on the supervisors was decidedly educational. In the accompanying illustrations the superintendent found out that his account was charged for cleaning off snow that fell the night before on the plant roadways. The supervisor of standards noted that the excellent repair job on his desk was done more economically than he had anticipated. The master mechanic himself found out that his painter had erroneously charged him for painting safety signs, a function of the personnel department.

This system does not apply to jobs which are done on an equipment order. Equipment orders are all estimated, and it is up to the maintenance department to live up to the estimate price.

Highly educational—itemized, but at small clerical cost—news instead of history—those are the advantages of the daily maintenance bill.





Watching Power Costs?

A signaling system eliminates excuses for oversight

TO HELP keep within the limits imposed by its rate schedule, the signaling system described was installed by the Sinclair Valentine Company, New York, manufacturers of printing and lithographing inks.

Alarm bells were mounted in the superintendent's office (above, right) and at the foreman's station in the plant on the floor below (lower left). Pilot lights were installed at these locations and a light was placed above the assistant superintendent's desk. Visual and audible alarms are therefore given simultaneously at three stations whenever the "danger point" is reached.

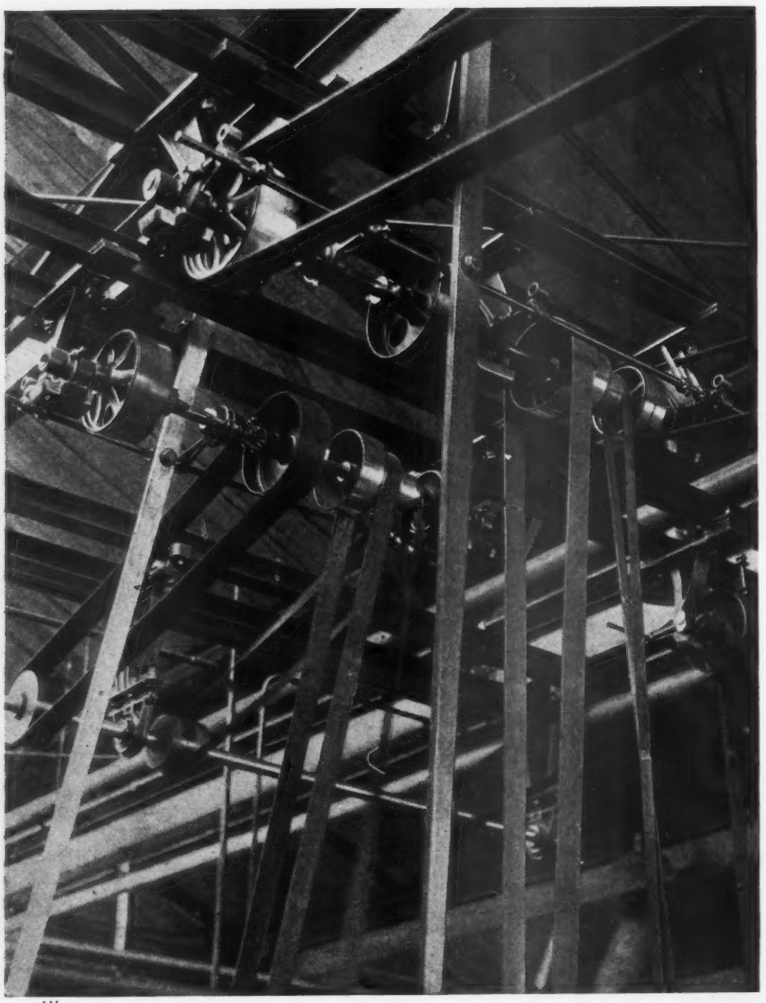
At such times it is the duty of the foreman to see to it that certain machines are disconnected from the lines, so that consumption for that half hour will not be excessive (the utility calculates demand charges for half-hour periods). The alarm circuits are energized by a set of contacts on the recording kilowatt meter seen above the superintendent's desk. Special dashpots prevent alarms being sounded on brief fluctuations.

The illustration in the upper left shows the "maximum demand station" in the plant. An integrating kilowatt hour meter gives the utility a permanent record, on a perforated tape, of the plant's electrical consumption. The superintendent's graphic kilowatt meter, although it is not integrating, gives him a similar record, for he can determine the power used over a given period by calculating the area under the curve on his graph.

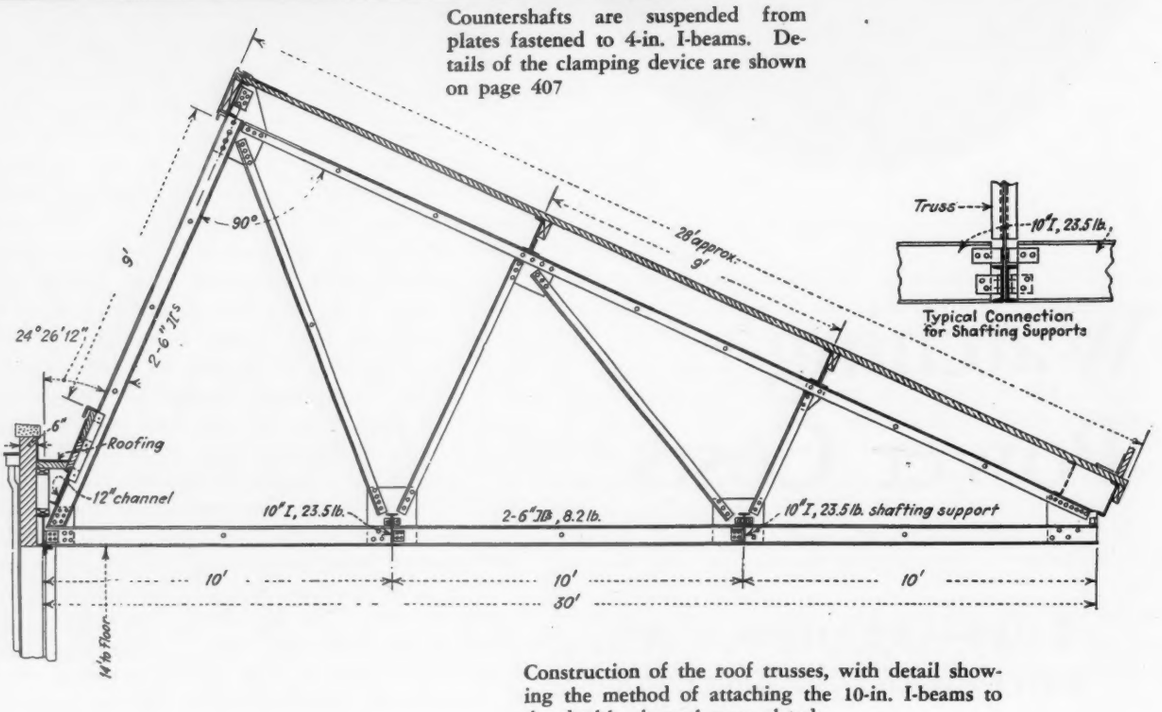
Supporting Shafts and Motors

C. A. Baden
Research Engineer
Norma-Hoffmann Bearings Corporation
Stamford, Conn.

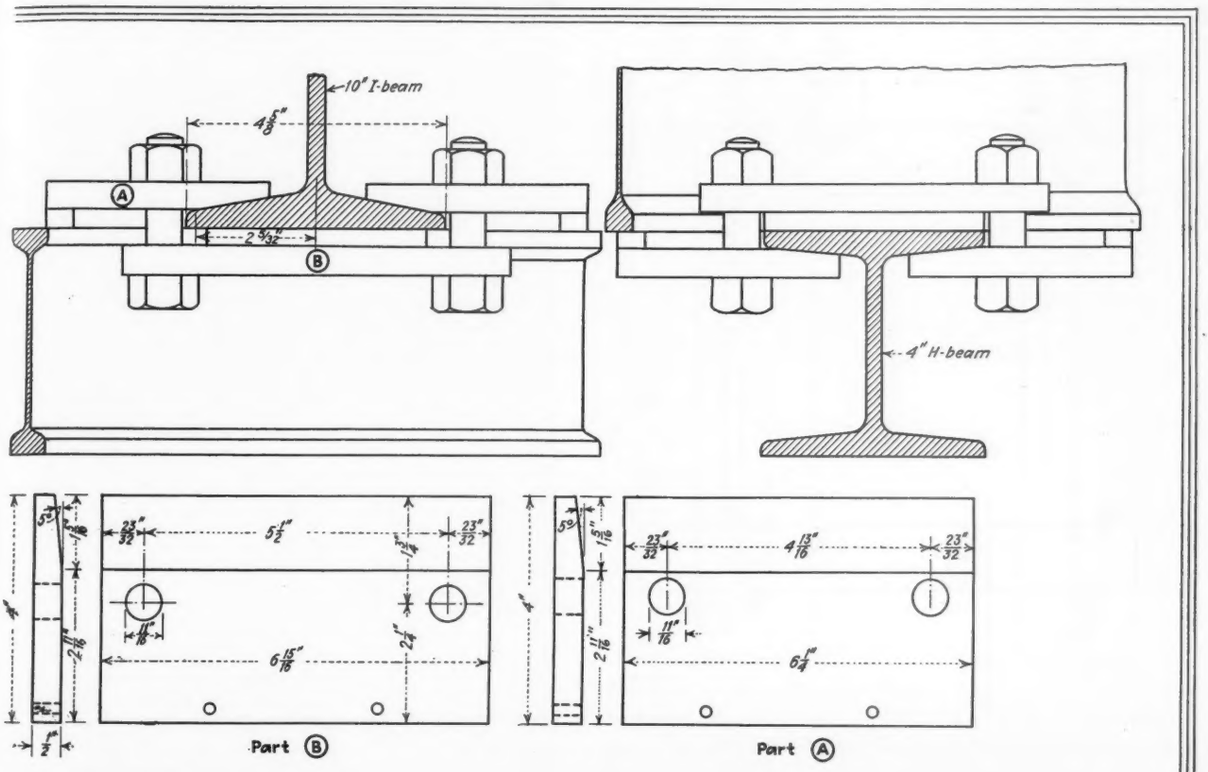
OUR FACTORY buildings have saw-tooth roofs. Shafting and motors for group drive had, therefore, to be supported from the truss chords, and the method of support had



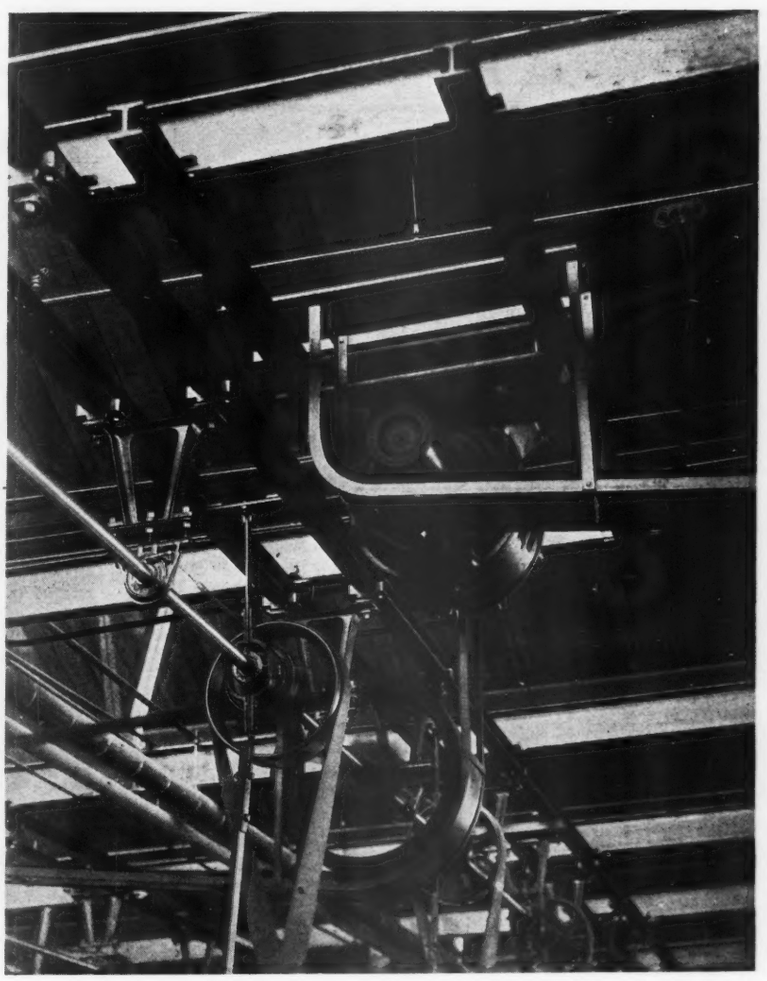
Countershafts are suspended from plates fastened to 4-in. I-beams. Details of the clamping device are shown on page 407



Construction of the roof trusses, with detail showing the method of attaching the 10-in. I-beams to the double channel truss chords



Detail of clamping H-beams to the I-beams. Tapered clamp plates fit the tapers of the H- and I-beam flanges snugly. Shims make the plates seat accurately when bolts are tightened



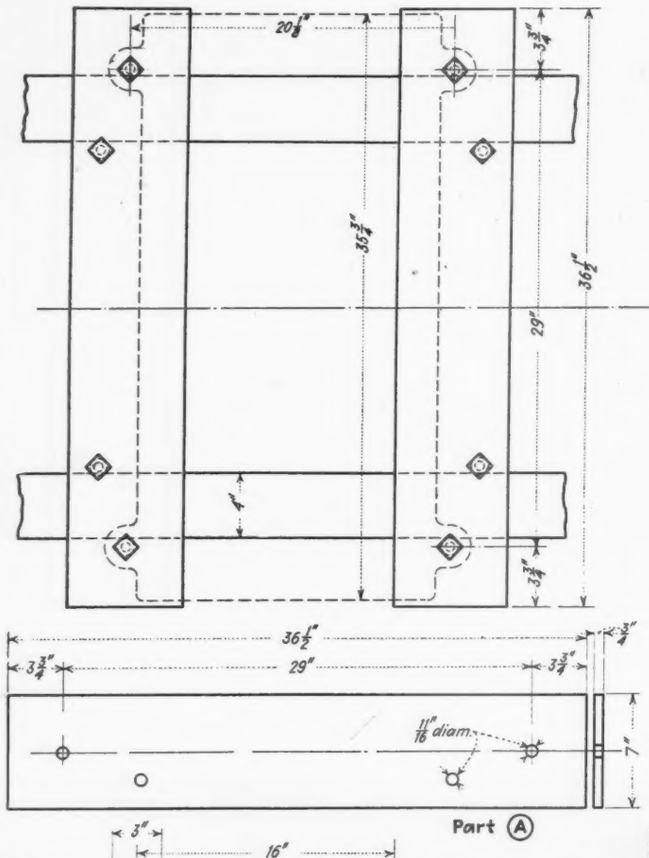
Motors are bolted to plates clamped to H-beams. Details of this mounting are shown on the following page

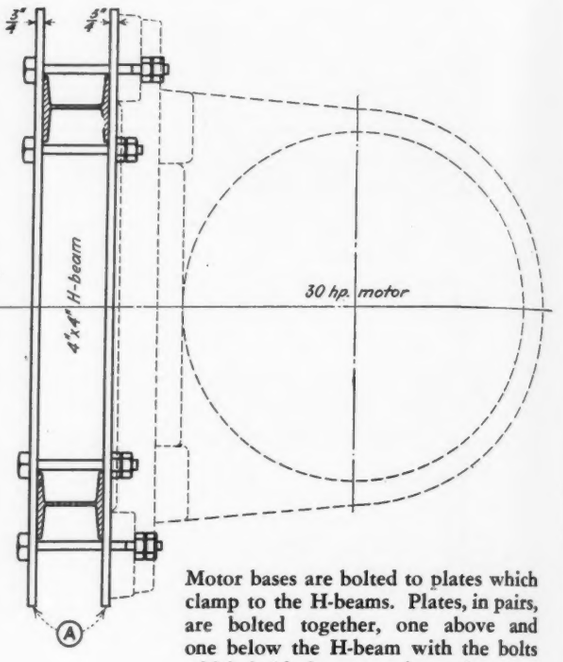
to provide ease of erection, flexibility in case a change were desired, and rigidity.

All our lineshaft hangers have anti-friction bearings; most have ball bearings, some roller bearings. These two types called for different mountings, and still other types of mountings were required for the motors and the countershafts.

The method of mounting the hangers and motors, as we worked it out, involves the use of 10-in. I-beams fastened at right angles to the truss chords. To the I-beams are clamped 4-in. H-beams or I-beams as required and, to these, plates or other beams are clamped to form the direct supports for motors and hangers.

Details of the construction and of the methods of clamping are shown on these and the two following pages. In the main a clamping device consists of a tapered plate corresponding to the taper of the beam flange and the necessary shim to provide support on the other side of the bolt.

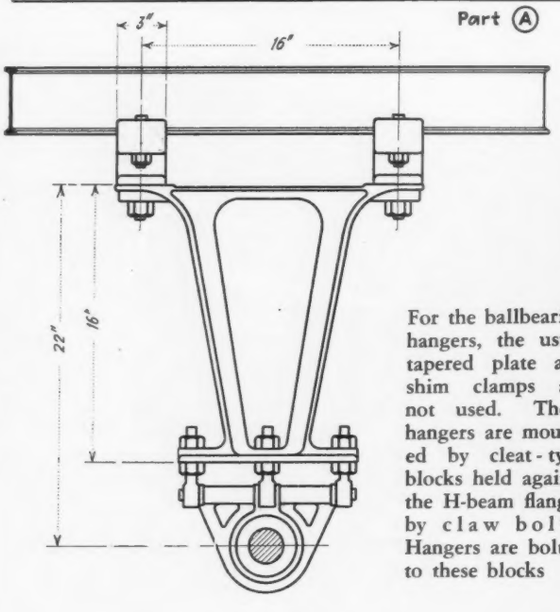




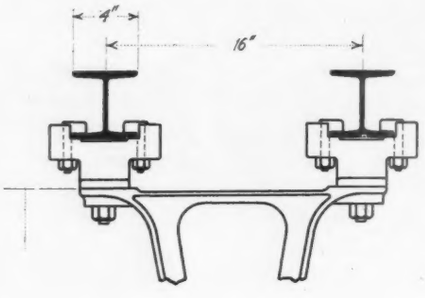
Motor bases are bolted to plates which clamp to the H-beams. Plates, in pairs, are bolted together, one above and one below the H-beam with the bolts which hold the motor base also passing through both plates and helping to clamp them to the beam

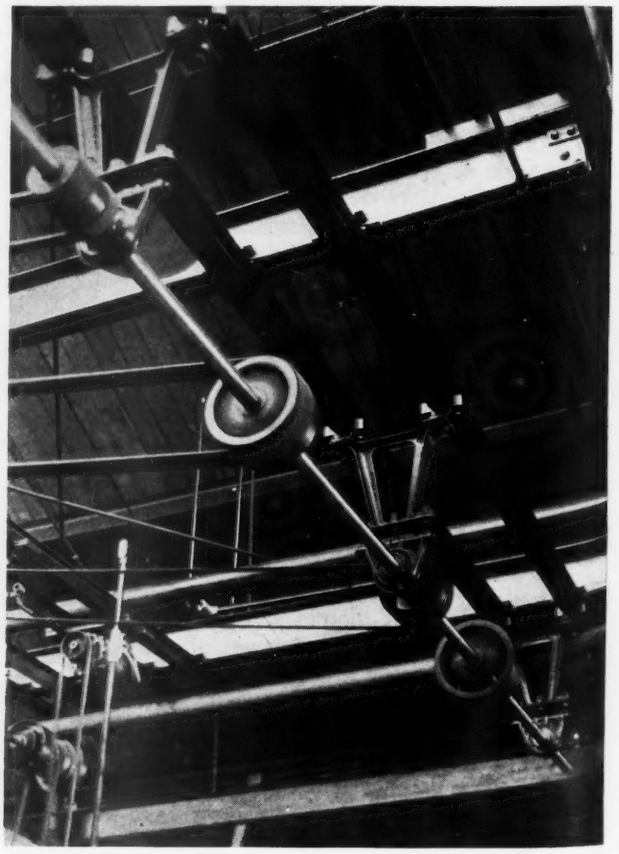
Part (A)

Lineshaft with ballbearing hangers clamped to H-beams by the method shown in the sketch at the left

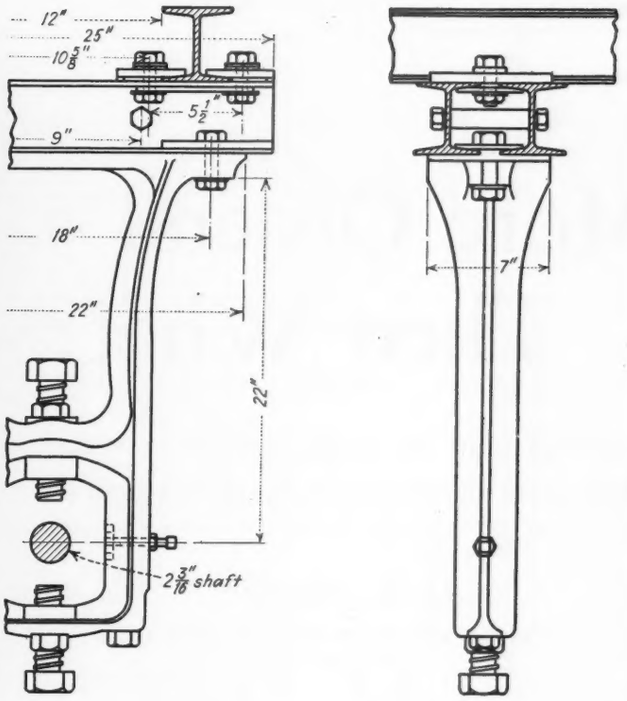


For the ballbearing hangers, the usual tapered plate and shim clamps are not used. These hangers are mounted by cleat-type blocks held against the H-beam flanges by claw bolts. Hangers are bolted to these blocks

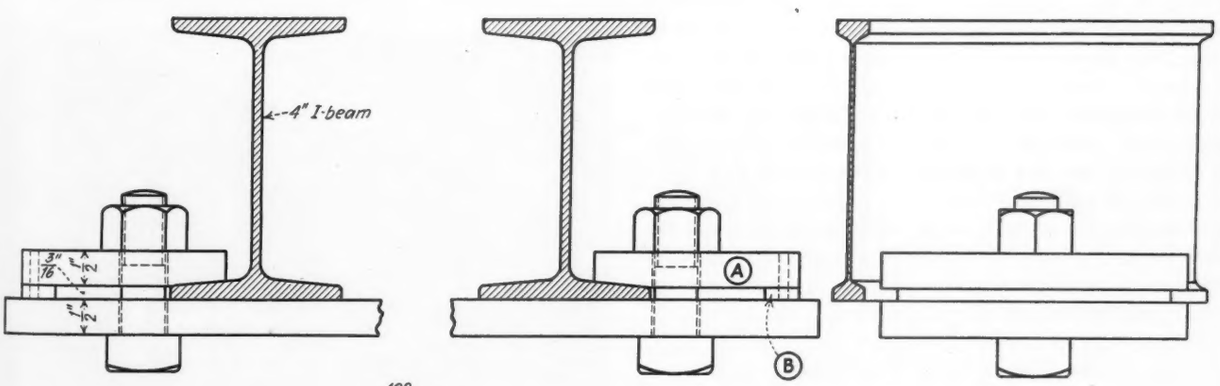


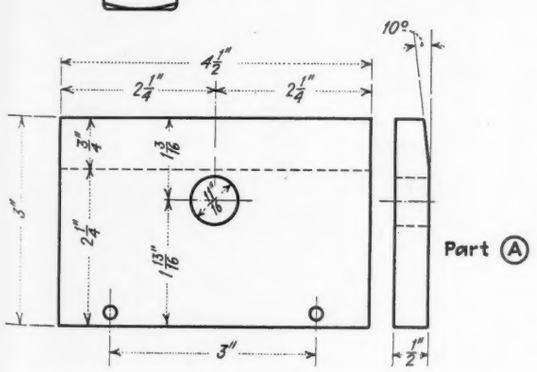


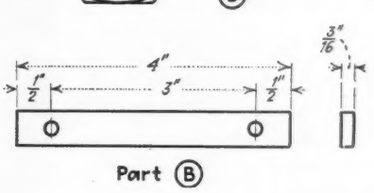
Roller bearing lineshaft hangers and the method of mounting them by H-beams clamped to H-beams. The plate and shim method is used



Side and end view of roller bearing hanger mounting. The side view, being symmetrical, is shown only in part







Countershaft hangers are bolted to plates clamped to I-beams by the tapered plate and shim method. The same mounting is used for fastening the fixed ends of shifting arms

More Orders! Then What?

Buildings must be ready, services in order. These three manufacturers found things to do

O. L. Merkt

Vice-President, Abbott, Merkt & Company
New York

BUSINESS is getting better. After four years of depression are plants ready to handle it? Do manufacturers realize that if they are to stay in the parade it is going to cost them something to walk?

That is my peculiar way of saying that they are going to have to make capital expenditures—little ones at first, big ones later. May I cite a few of the little ones that have been made, and point out their effect?

There is the experience of container manufacturer *A* who found that the quality and cost of the work in the printing department had for some time not been up and down, respectively, to standard. Investigation showed that there had been an unperceived but constant change from black and white to color work. Plant lighting, however, had not changed; good enough for black and white, it was poor for color. To correct the deficiency a long, saw-tooth roof, with windows, was installed over one section of the building. As a result of the uniform, diffused light obtained, rejections decreased remarkably, work went faster, costs fell.

This Plant Moved Washrooms

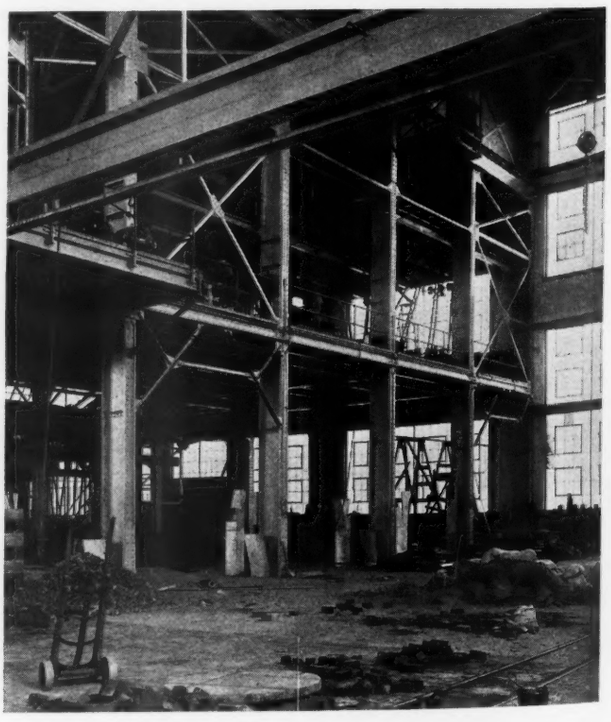
Then there is manufacturer *B*. Despite dust masks and modern washrooms, his employees indulged in an unusual amount of lost time because of lead poisoning. Cause and remedy lay in the location and relocation of those same irreproachable washrooms. While all the trouble was going on they were located in a building adjacent to the main plant. Workers, rather than go to another building, would eat lunch without washing. Relocation of the washing facilities in a room constructed in the main plant caused so great a reduction in the claims for losses that the company made a notable saving. A helpful aid, in this case, was the proximity of the time office to the washroom; washing up and checking out were almost one and the same motion.

A third case is that of manufacturer *C*, whose plant covered approximately the area of a city block. Originally the plant consisted of a one-story and a two-story brick building. As the business grew, frame additions were built. Only a fraction of each building was being used for manufacturing operations, the remainder for storage of material, obsolete equipment, useless odds and ends. Inefficient handling resulted, of course.

The original brick building, which was structurally sound, was remodeled, a small one-story brick structure was added, and all the operations were concentrated in those two buildings. One of the existing frame buildings was retained, fitted with racks, and used for the storage of material required for manufacture. The remaining frame buildings were demolished, the obsolete equipment and collection of miscellaneous material were disposed of, and a section of the property was then leased for a filling station.

The saving in maintenance costs, insurance, and taxes, plus the rental received from this section of the property, to say nothing of the increased efficiency of the factory, represented a high return on the money spent.

From a knowledge of these three typical cases and many other similar ones I feel justified in drawing several conclusions: Every plant should be analyzed from every angle, by its own personnel certainly, by outside engineers in many instances. What seem to be paltry advantages to be gained from minor improvements may turn into nice income items on cost reductions. A proper analysis of repairs necessary for efficient operation may indicate that complete plant modernization will be cheaper in the long run. Money spent to lessen the hazards and annoyances of workers is earning more than if it were in the bank.



Formerly equipment made at this plant had to be assembled outdoors. To concentrate all operations in a smaller area this erecting shop was built with galleries at the side for light work

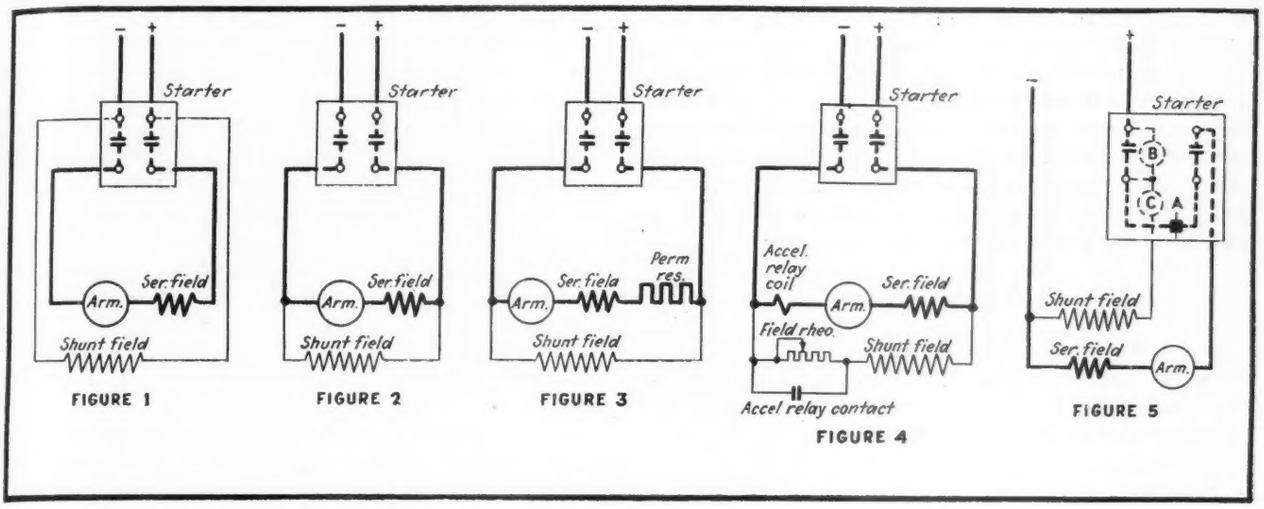


FIGURE 1 FIGURE 2 FIGURE 3 FIGURE 4 FIGURE 5

Line Starting of D.C. Motors

L. E. Markle

Control Engineering Department
Westinghouse Electric & Manufacturing Company
East Pittsburgh, Pa.

MOST direct-current motors require some form of starter that will first apply reduced voltage to the armature, then gradually accelerate the motor to full speed by increasing the armature voltage until full-line voltage is applied to the motor terminals.

With compound-wound d.c. motors of small rating, approximately 3 hp. maximum, it is often permissible to connect the motor directly to the source of supply without intermediate devices to apply reduced voltage at starting. On installations that permit line-starting, the motors are usually of the constant-speed, compound-wound type or can be operated over only a limited speed range by shunt field control. With line-start installations it is only necessary to close a switch in order to start the motor. Best operating conditions for a given installation can sometimes be obtained by proper attention to the manner in which connections are made.

Maximum Starting Torque

Figure 1 shows the circuit that provides maximum torque for starting. Since the torque of a motor depends directly upon its field strength and the armature current, the maximum torque is available when the field current and armature current are simultaneously at maximum values. In Figure 1 the shunt field is energized even though the starting switch is open and the motor is at standstill. When the starting switch is closed, the armature current instantly rises to a high value, which is limited only by the resistance of the armature circuit, and the motor exerts its maximum torque at the instant the switch is closed. Such connections cause the motor to start with a sudden jerk. If a belted drive is used the belt may be thrown off. With a geared drive there may be a heavy shock on the gears and the driven machine. However, if the load is difficult to start, the high torque at starting and the resultant shock may be desirable for breaking the static friction and starting a load that the motor might not otherwise be able to handle.

Connections in Figure 1 may not be permitted with some motors because the field is energized when the motor is at standstill. Lack of ventilation and cooling that normally result from a rotating armature may cause overheating of the field circuits.

Figure 2 represents the usual scheme of connections when a d.c. motor is started by connecting it directly to the power supply. With this scheme the motor field is de-energized when the motor is at standstill; so there is no danger of overheating the fields at standstill and no loss of power.

The maximum torque is not available at the instant the starting switch is closed, but it is available very shortly thereafter, depending upon the time required for the shunt field current to reach its maximum value;

due to the inductance of the shunt field the current does not rise to maximum value instantly. Since the armature current rises to its maximum value almost instantly, in less time than the shunt field current, it is evident that the motor torque increases to its maximum at the same rate that the shunt field current increases to its maximum value. As a result the motor torque is applied less suddenly than when connections are made as in Figure 1, and the motor starts the load with less shock.

Less Starting Shock

Figure 3 shows a scheme of connections that will start the motor with less initial torque and shock than if it is connected as in Figure 2. In this case the armature current is limited by the permanent resistor in the armature circuit.

For most applications this scheme is not desirable because of the power lost in the permanent resistor while the motor is running. It is, however, a very satisfactory connection where the motor starts a heavy inertia load that requires a long time for starting; where too much starting torque might damage machinery; and where very little power is required to drive the load after it has been started, and the loss in the permanent armature resistor is negligible. A typical example of such an installation is a heavy centrifugal machine.

Line-start d.c. motors are usually constant-speed motors. The term "constant speed," however, sometimes implies that a small amount of speed increase is permissible by shunt field control. In such cases the speed control is most easily obtained by using a field rheostat in series with the motor shunt field, as Figure 4 indicates.

If the field rheostat in Figure 4 is left in the high-speed position the motor, upon starting, will require a higher armature current with the weakened shunt field than if the rheostat were set for low-speed or maximum shunt field strength. The high value of armature current may prevail throughout the greater part of the accelerating period and cause damage to the motor commutator. Damage to the commutator can be avoided and satisfactory starting of the motor accomplished, as in Figure 4, by the use of an accelerating relay.

The accelerating relay has a current coil connected in series with the armature and contacts connected in parallel with the shunt field rheostat. When the motor armature current is within safe values from the standpoint of not damaging the commutator, the accelerating relay contacts are open and the shunt field rheostat is effective. If the armature current exceeds the value for which the relay is adjusted the relay contacts will close and short circuit the field rheostat. As long as the armature current is above the value for which the relay is set the relay contacts remain closed and the motor operates at maximum field strength and is able to deliver the same torque at lower armature current than is possible with weakened shunt field strength.

As the motor accelerates the armature current decreases until it reaches a value so low that the coil of the accelerating relay permits its contacts to open and re-insert the rheostat in the shunt field circuit. Obviously, the relay may operate a number of times during the acceleration period, depending upon the load on the motor and the relay setting. Since the relay is usually set at not less than 125 per cent of full-load current, it does not operate when the motor is running under normal load conditions.

Figure 5 shows a circuit that provides maximum torque for starting, as in Figure 1, but eliminates the objection of excessive power consumption in the shunt field while the motor is idle. This feature is obtained by a magnetic timing device that permits the shunt field to reach its maximum value before power is applied to the armature.

In Figure 5 unit *A* is a timing device whose contacts are capable of carrying the motor armature current, just like a magnetic contactor used on automatic starters. It has two coils designated as *B* and *C*.

When power is applied by closing the circuit disconnecting switch, current flows from the positive side through the two coils in series with each other, and then through the shunt field and to the negative line. Coil *B* will immediately open the contacts of the timing device, which are closed in Figure 5 because it is shown with all power disconnected. Coil *B* is of relatively high resistance so that the current through the shunt field is small and the power consumption is low in the event that the disconnecting switch is left closed. The low power consumption of the shunt field is a decided advantage, but at the same time some heating is often desirable to prevent "sweating" and consequent damage to motors by moisture when idle, and when located in cool, damp places.

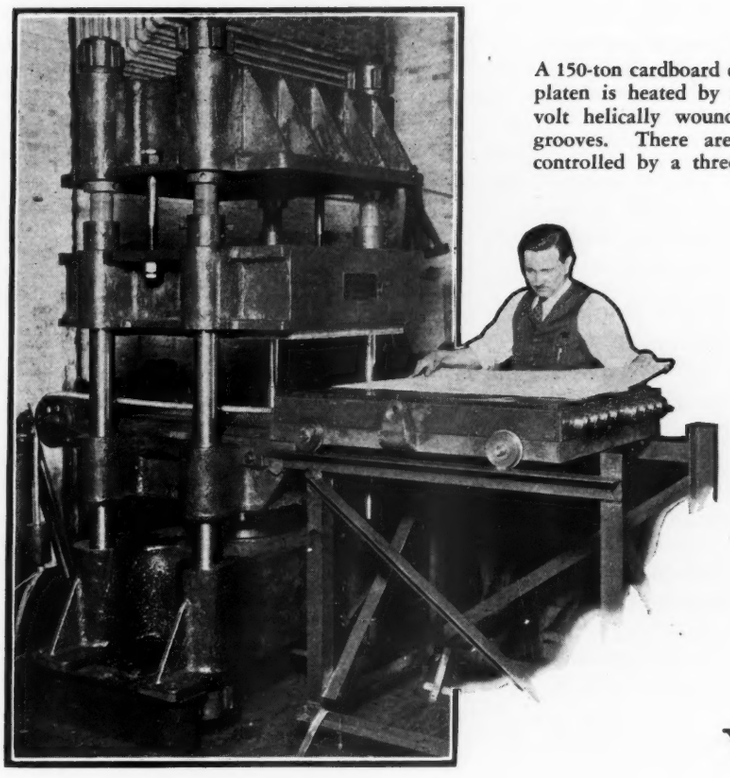
Delayed Motor Start

When the motor starter is operated it does not start the motor instantly, because the contacts of the timing device are open. One contact of the starter parallels coil *B* and except for residual magnetism the contacts of the device are free to close and start the motor. In the meantime the shunt field strength is rising to its maximum value because coil *C* is of such low resistance that it has practically no effect on the shunt field current.

When coil *B* was short-circuited by the starter the residual magnetism was sufficient to prevent the timing device contacts from closing. The small coil *C*, however, is wound opposite to coil *B*, and it immediately starts to neutralize the effect of coil *B* and reduces the residual magnetism to zero, whereupon the contacts of the device close and the motor starts.

The time required for coil *C* to reduce the residual magnetism of the timing device to zero depends upon the current passing through coil *C* and the number of turns on it. By properly selecting the coils with respect to the motor shunt field characteristics the timing device will always permit the motor shunt field to reach its maximum value before it applies power to the motor armature. When the motor is stopped coil *B* immediately opens the timing device contacts and reduces the shunt field to a minimum value.

Starters illustrated in Figures 1 to 5 may be of different types. Manually-operated, drum-type switches are frequently used. Small circuit breakers that provide overload protection are desirable on some installations. The magnetic line starter which provides overload protection and remote control by push-button or similar master switch is also available.



A 150-ton cardboard embossing press whose platen is heated by sixteen 500-watt, 220-volt helically wound units clamped into grooves. There are eight circuits, each controlled by a three-heat snap switch

R. M. Cherry
Industrial Engineering Department
General Electric Company
Schenectady, N. Y.

What Type Electric Heating Units?

A PRECEDING article, August issue, explained how the heat requirements are calculated for applications that make use of small-sized electric heating units. Construction of these units and the uses for which they are intended will be discussed in this article.

In general, small heating units are available in the following five types: (1) Cartridge unit; (2) strip heater; (3) immersion heater; (4) helically wound unit; (5) cast-in, helically wound unit.

All of these types of units are available in various sizes and electrical ratings. Each is also given a maximum temperature rating, based on the application and the kind of material used for the outer sheath of the unit.

Cartridge Unit

This unit consists of a resistance wire wound on a core of lava and insulated from the outer sheath by compacted magnesium oxide. The two terminals are brought out from the same end. It is used principally for heating metal parts, the unit being inserted in a drilled hole. Typical applications are heating small hot plates, metal blocks attached to some other part which is to be heated, such as a gluepot, and supply heat to valves or other devices.

The cartridge unit is available in a great variety of sizes and ratings, inclosed in brass, nickel silver, chrome steel and other sheath materials. Maximum temperature allowable for some of these sheath materials is:

Sheath Material	*Maximum Sheath Temperature*
Brass	750 deg. F.
Nickel silver	1,000 deg. F.
Chrome steel	1,200 deg. F.

For the great majority of applications of the cartridge unit the brass-sheath unit is suitable.

Size and rating of cartridge units and type of sheath material required can be readily selected when the temperature required for the part to be heated and the temperature drop between the sheath and the part are known.

A clean unit in a hole with a clearance of not more than 0.010 in. will have a temperature drop between the sheath and the metal of about 8 deg. F. per watt per square inch rating of the unit. Knowing the size and electrical rating of the standard, listed units, the watts per square inch rating can be readily determined.

Take the case of a cartridge unit rated 30 watts per square inch of sheath surface, installed in a steel plate to be kept at 300 deg. F. The temperature drop between the unit and the steel plate will be approximately

$8 \times 30 = 240$ deg. F.; therefore the sheath temperature will be $300 + 240 = 540$ deg. F., which is well within the temperature allowable for the brass sheath.

Strip Heater

The strip heater consists principally of a spiral-wound resistor and suitable spacing insulators in a flat metal sheath or tube, insulated by compact magnesium oxide. It is used principally to heat air in small ovens or furnaces, and as a clamp-on heater for hot plates, warming tables, and so on.

Two types of sheath materials are used—steel, having an allowable maximum temperature of 750 deg. F., and chrome-steel having an allowable temperature of 1,200 deg. Fahrenheit.

Heating of small ovens represents a typical application of strip heaters. The unit should be mounted at the sides of the oven or located so that there is free circulation of air around it.

Steel-sheath heaters are suitable for oven temperatures up to 400 deg. F. For oven temperatures up to 800 deg. the chrome-steel sheath heater should be used.

When used as a clamp-on heater for heating hot plates, warming tables, and so on, the heater must be tightly clamped to the surface.

The temperature drop between the heater sheath and the surface to which it is clamped will depend upon: (*a*) The area in actual contact; (*b*) The watts density rating of the heater; (*c*) Temperature desired on the part heated; (*d*) Rate at which heat is to be removed from the part; (*e*) Condition of the surface of the part to be heated.

For estimating purposes allow about 18 deg. F. per watt per square inch of actual surface contact as the temperature difference between the unit and the part heated.

Assume that a standard, 23½-in. steel-sheath unit which has 20 in. active heating length, 1½ in. wide, rated 500 watts, is clamped underneath a steel plate. This unit provides 30 sq.in. of contact surface and 16.7 watts per square inch of actual contact. The temperature difference will then be about $18 \times 16.7 = 300$ deg. F. Since the steel sheath is limited to a maximum temperature of 750 deg. F., the maximum plate temperature for which it is suitable is about 450 degrees.

Immersion Heater

These units are suitable for immersion directly in the liquid to be heated.

They consist of a resistor wire coiled into a helix and insulated by compacted magnesium oxide from the outer sheath, which is formed into the desired shape and fitted with a suitable plug for screwing into a tank, or with terminals for hanging over the side of a tank.

These units are made in various standard diameters, lengths, and electrical ratings, with several types of sheath material. Some of the common sheath materials are nickel silver, copper, monel metal, steel, chrome steel, and other nickel-chrome steels.

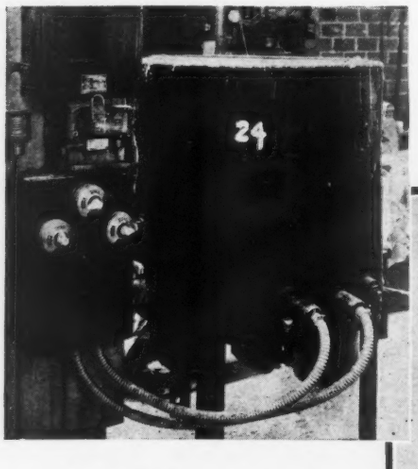
The immersion heater must be installed so as to permit free circulation of the liquid around the unit and keep the entire unit covered with liquid.

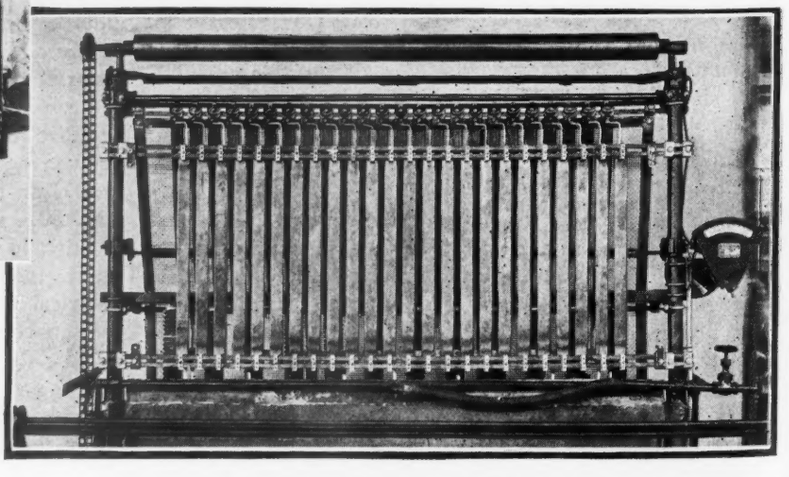
Since water is an excellent medium for the absorption of heat, water immersion units are normally rated at about 40 to 50 watts per square inch of sheath surface. It is conservative practice to figure approximately 3.5 deg. F. per watt per square inch rating of the unit as the temperature difference between heater and water.

When applying the immersion unit to the heating of oil, the heat density must be lower than for water, since oils in general do not have the ability of water to absorb and transfer heat. Also, oils are likely to break down and leave a deposit of carbon on the sheath of the unit or on the side of the tank, if external heating is used. Standard oil immersion heaters are normally rated about 20 watts per square inch of sheath surface. To estimate the temperature difference between the sheath of the unit and the oil, allow approximately 7 deg. F. per watt per square inch on the sheath surface.

The sheath material used for oil immersion units depends upon the characteristics of the oil in which it will be immersed. In most cases, the oil to be heated

(Continued on advertising page 68)





This paraffin melting pot (above) is heated by four immersion units. Temperature is automatically controlled. Strip heaters supply heat for drying blueprints

16 Basic Maintenance Principles

C. J. Stuart

Industrial Engineer, New Haven, Conn.

THERE are certain principles of maintenance organization and procedure that I deem necessary to meet efficiency requirements. I have formulated these principles after extensive experience in maintenance work, and recently set up the maintenance function according to them in a group of twenty-four plants. The principles are as follows:

Buildings, Equipment, Personnel

1. Buildings, machinery, and equipment are to be maintained in good working condition.

2. All maintenance work is to be under the direction of one man, the Plant Engineer.

3. In the larger plants all maintenance work is to be under a master mechanic, reporting to the plant engineer. In the smaller plants the maintenance group foremen are to report to the plant engineer.

4. Maintenance workmen are to be divided into four working groups: machine (machinists, oilers, machine inspectors, blacksmiths, ironworkers, welders, tinsmiths, tool-mold-die repairers, and helpers); carpenter (carpenters, millwrights, patternmakers, painters, masons, and helpers); pipe (pipers, plumbers, and helpers); electrical (electricians, motor inspectors, substation attendants, and helpers).

All groups are to cooperate on a mixed job, working under the direction of the group foreman having the major part of the job.

All heads of these groups are to be working foremen except in the larger plants where a group foreman having ten or more men in his group can spend all of his time in planning and supervising the work of his men, with working sub-foremen to handle specific jobs.

Policies for Procedure

5. The headquarters or shops of these groups of workmen are to be together, near the center of plant operations where practicable.

6. Maintenance work is to be done on a preventive rather than a breakdown basis. There are to be regular motor and machine inspections. Production foremen will cooperate in reporting the need for small conditioning repairs. Oilers are to watch the condition of machines and equipment when oiling. All maintenance workmen are to keep their eyes open for poor conditions.

7. In production departments, where special repair men are necessary, they will come under the maintenance head for their class of work. As few as possible of these special men will be kept in production, consistent with production requirements; in emergencies, or when behind in their work, they will call on the regular maintenance group for assistance.

8. Helpers in all maintenance groups are to be used interchangeably between groups, as the amount of work warrants, helpers rather than journeymen to be used on rough work, no helper to be used with a journeyman unless the job requires more than one man.

9. General maintenance supplies are to be kept under control of maintenance stores and issued to workmen on work orders. Special machine parts or supplies used in only one production department are to be kept in a locked special cabinet, in that department, so that a workman will have replacing parts handy. The key to these special cabinets is to be kept in the maintenance department and will be issued to a workman going to do a repair job in the particular department. The workman will make out an order for any parts used from these cabinets and deliver it to maintenance stores so that the records may be kept in order.

Transporting Men, Tools, and Supplies

10. In the larger plants, electric trucks are to be available to convey men, tools, and materials between jobs and maintenance department, the regular factory trucking department to cooperate on this.

11. Maintenance work is to be done on orders signed by the production foreman in whose department the work will be done and which will be charged with the repairs. Small recurring jobs are to be done on a monthly open order for each department.

12. All maintenance jobs over $10 are to have the labor expense estimated and checked against actual labor used by the maintenance department.

13. All maintenance orders entailing over $25 total expense must be approved by the plant engineer; those entailing a total expense over $100 must be approved by the plant manager or other chief production executive.

Keeping Foremen Informed

14. Each production foreman is to be furnished a monthly summary of the maintenance expense charged to his department; the plant engineer is to get monthly summaries of maintenance expense of all departments.

15. Maintenance department machines and equipment, including portable tools, are to be brought to a modern, efficient basis; surplus and obsolete equipment is to be discarded.

16. All maintenance work done by outside shops is to be done by getting bids and letting a contract where practicable.

How to Maintain Instrument Accuracy

J. Sayre Christie
Christie Laboratories, Inc., Cleveland

WE WANT to obtain great accuracy and long life from meter equipment. So let's begin with a meter as it arrives in the plant shipping room. Unpack it carefully. When the container is of wood, and the lid is fastened with screws, don't pry the lid loose with a nail puller; use the screwdriver. The screws were used to avoid jar in packing and unpacking.

Remove the instrument from the container carefully to avoid damaging the jeweled bearings. Then get the instrument out of the shipping room at once, before something happens to it.

Learn all you can from the manufacturer's method of packing, because sooner or later you will ship a meter out for repairs. When you do, choose a container that allows several inches of packing material all around the meter. If a wooden box is used, screw the lid on, don't nail it. Careless packing of an instrument often results in more damage than was the original cause for its return.

Installation

In drilling the switchboard for mounting an instrument, allow sufficient clearance to avoid placing the instrument under strain; tension can cause mechanical damage or friction in some of the moving parts. Watthourmeters and other types of recording instruments often have been put out of commission by improper installation.

Direct-current meters of all types should be so situated with relation to each other and to external buses as to avoid the influence of stray electrical fields. The distance between meters of this type is governed largely by the adequacy of shielding. Six to ten inches is about right. The distance from power lines or heavily charged buses depends upon the strength of the field, and is best determined by experiment.

With shunt types of ammeters and watthourmeters use the leads or cables furnished for connecting the meter to the shunt without any alteration in length or cross-section. These leads are an integral part of the meter element, and are calibrated with the instrument. Altering them will inevitably result in instrument inaccuracies. Voltmeters, wattmeters, and watthourmeters designed for high-voltage use should be carefully checked before being connected to the line to assure the proper installation of external resistors or multipliers when they are supplied.

Alternating current instruments are less affected by stray magnetic fields, but in polyphase installations extreme care must be taken in making connections to preserve the right phase relations. For any type of instrument using current transformers, it is not only essential to respect the correct current ratio for the particular instruments, but also to avoid an open-circuit condition in the transformers.

Current transformers should be short-circuited at their secondary terminals, or connected to the current studs of the meter, before current is permitted to flow. Otherwise a dangerously high potential builds up within the secondary winding and may cause breakdown in insulation and consequent destruction of the transformer.

Friction in electrical instruments is almost always the result of wear of pivot points with continued use, from vibration, or from dropping. Jewels may be cracked by rough handling, by strain in mounting, or by sudden changes of temperature. Magnetic particles frequently find their way into the air gap between the pole pieces and core of d.c. instruments, causing the moving element to stick. Small pieces of lint from the insulation protruding from the moving coil may cause unsatisfactory operation.

ALWAYS

1. **Replace broken or loose glasses to prevent dust collecting on meter insides.**
2. **Keep all connections clean and tight.**
3. **Use resin dissolved in alcohol for a flux for soldering all internal connections.**
4. **Keep instruments clean externally. The user will instinctively handle a clean meter with more care.**
5. **Connect to the highest scale if uncertain of the values to be measured when using multiple-range instruments.**
6. **Allow meters to assume "room temperature" before checking for accuracy.**
7. **Use all portable meters in a horizontal position unless otherwise instructed by the manufacturer.**
8. **Allow sufficient room for subsequent, periodic checking when installing meters, shunts, or instrument transformers.**
9. **Avoid an excess of ink in graphic meters as much damage can be done by its corrosive action.**
10. **Check promptly meters which have been subjected to an "overload." Their accuracy may have been impaired.**

A section of our laboratory devoted to servicing instruments. Obviously not just any maintenance department can do this kind of work

Accuracy, then, demands that any irregularity in operation be noted and the cause found and eliminated before more serious trouble develops. When any trouble in the operation of instruments is noted, the apparatus should be returned to the manufacturer or to an authorized service laboratoroy for inspection and any necessary repairs.

And don't oil meters. Not infrequently upon the removal of the case or cover plate of a meter sent in for examination, quite an amount of oil will run out, indicating that somebody thought a dose of lubricant was needed. This is about the worst remedy that can be inflicted upon an electrical instrument. Lubrication is never used on the bearings of electrical instruments, except in the case of watthourmeters or other similar measuring apparatus where a continuous rotation is maintained.

In most indicating instruments the bearings consist of two finely ground and polished steel pivots, placed in opposite ends of the moving coil or system, and supported between two finely polished cup-type jewels. The bearing surfaces are of needle-point magnitude, and obviously friction will not be lessened by any means of lubrication. Even if oil were used, great care would have to be exercised to prevent it from spreading to the torsion springs and causing the convolutions to stick together.

NEVER

1. **Use any metallic tool on the inside of a meter while it is still connected to a circuit.**
2. **Attempt to tighten jewel screws; the slightest pressure will injure bearings.**
3. **Use acid or paste soldering flux on the inside of meters or when soldering fine wire.**
4. **Read a meter directly after cleaning its glass; a static charge may cause error. Blowing the breath on the glass will usually dissipate such a charge.**
5. **Check voltmeters in series.**
6. **Check ammeters in parallel.**
7. **Open an instrument, particularly one with a permanent magnet, when iron filings, steel wool, or other magnetic particles are present.**
8. **Put portable meters on generator or motor bases, or on other masses of iron, as the magnetic, shunting effect may cause inaccuracies in the readings.**
9. **Patch a broken pointer on a meter and expect accuracy; the unpoised condition will affect the readings.**
10. **Buy instrument accuracy on a price basis. The internal—not the external—qualities are the essential requirements.**

Test Apparatus

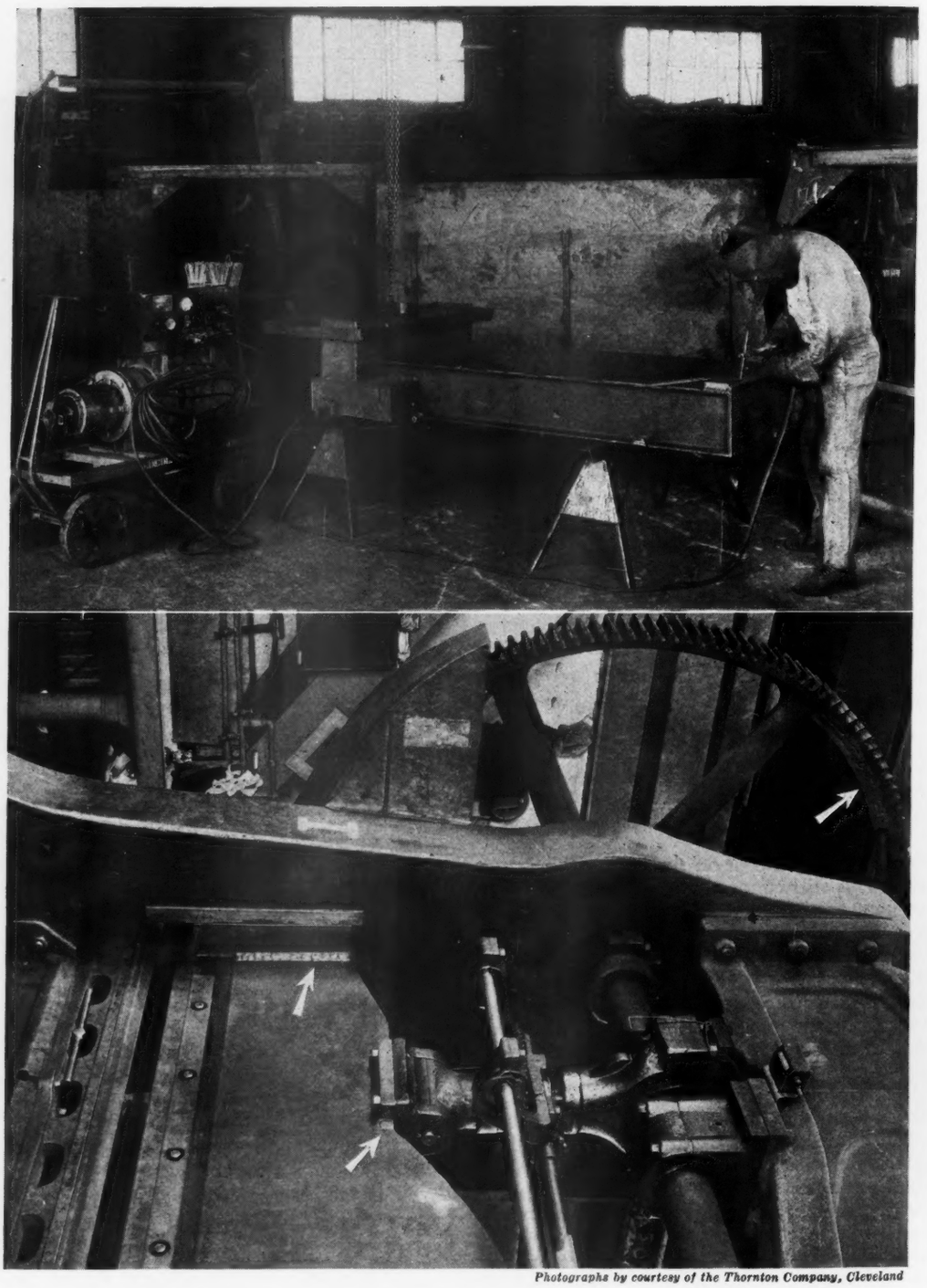
Routine checking of instrument accuracy should be as much a part of plant operation as the keeping of production figures. The single purpose of all instruments is accuracy, whether of record or control. It is only common sense to keep them working properly.

Select portable test instruments to meet the general requirements of the plant. For a.c. watthourmeters, the best test equipment is the portable test meter (rotating standard) and phantom load box. These test standards retain their accuracy long and can usually be checked at the laboratory of the local power company.

For a.c. wattmeters, ammeters, and voltmeters, the most convenient test instruments are: A voltmeter

(Continued on advertising page 72)

Saving by Welding



Photographs by courtesy of the Thornton Company, Cleveland

A plate ram replaces a broken cast ram on a power brake, at one-third the cost. Although 3½ inches thick and 12 feet long, relatively little welding was required. The 7-foot cast-iron gear also was welded; a wrought-iron backing plate was applied to give strength to the thin rim section. Four years of service for this brake since welding. Cast machine bases involve costs of patterns, molds, iron, and machining. The fabricated base shown was made at a total cost less than the cost of a pattern. The welder, appropriately enough, uses welded sawhorses for supporting the work.

MAINTENANCE SHORTS

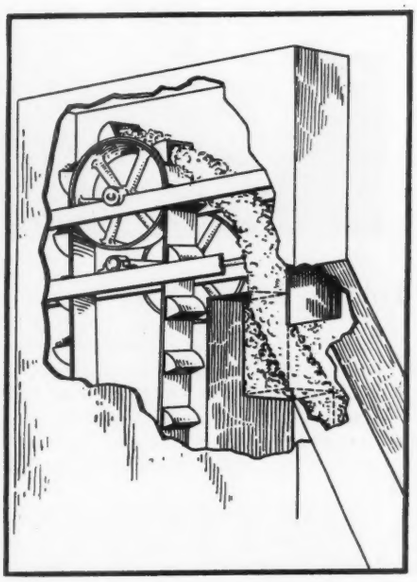
Baffle Plate and Box Prevent Wear

LINCOLN MILLARD, Philadelphia

The abrasive character of the handled material coupled with the centrifugal force with which it is delivered from the heads of our elevators kept us continually patching chutes and replacing wear plates. The abrasive material was delivered directly into the mouths of the chutes, striking with considerable force and with a glancing blow.

To prevent this excessive wear our maintenance department installed a steel baffle plate in the line of force at the mouth of the chute. Immediately below the baffle a box or set-back was built in. Now the material as it is discharged from the conveyor, strikes directly against the baffle plate, falls into the box and when the box is filled, overflows into the chute.

The baffle plate, easily changed, takes practically all the wear. The top and sides of the chute are relieved from abrasive action and along the bottom of the chute the material travels more slowly than formerly, causing less wear.



Mr. Millard's contribution has been awarded the $10 payment offered by the editors for the best Maintenance Short submitted dur- the past month.

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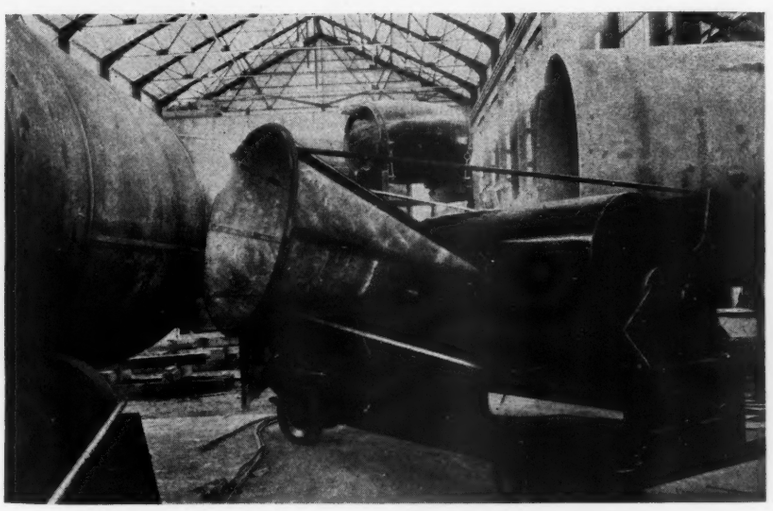


Boulder Canyon Pipe Tested by X-Ray

SOURCE, Babcock & Wilcox Company

To prove the soundness of the welds in the pipe now being fabricated for the Boulder Canyon project, mobile X-ray apparatus of 300,000-volt capacity is used. The X-ray machine is taken to the pipes because of their size, some of them being 30 feet in diameter and made of plates as thick as $2\frac{3}{4}$ inches.

Sections of these pipes, 12 feet long, are fabricated by joining together, by fusion welding, three suitably curved plates. Pressure to which the pipes will be subjected will be as high as 300 pounds per square inch, with allowance for water hammer.

The X-ray photographs show such defects as marked porosity, slag inclusions, and incomplete fusion.

•

Finding Power Output of Electric Motor

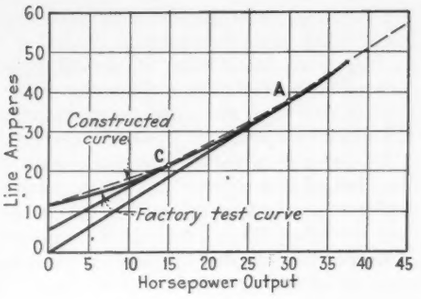
I. J. RAND, Electrical Engineer
Columbia Electric Manufacturing Company
Cleveland

To measure the horsepower output of a motor the usual procedure is to take a wattmeter reading of the power input and then assume an efficiency for that load in order to calculate the output. Factory test data are usually not available; consequently the efficiency for the load under which the motor is being tested must be assumed, which immediately introduces an error, the size of which depends on the guess of the observer.

A method that is much simpler and sufficiently accurate for average requirements involves merely measurement of the motor current. Use is made of a curve obtained by plotting line amperes against horsepower output. From this curve the horsepower output corresponding to the current input for any load may be readily determined.

The factory test curve for a 30-hp., 440-volt, three-phase 60-cycle, 900-r.p.m. motor is shown. The full-line curve was obtained by actual load test at the factory. The dotted line curve is approximated by the use of the ammeter, as follows:

Location of point *A*, full-load amperes, is obtained from the nameplate. Point *D* is obtained by measuring the current of the motor running idle. Draw line *OA* from zero through the



full-load point *A*, and extend it for overload points. Draw a line *BA*, with *OB* being one-half of *OD*. Draw *DC*, *C* being the point of intersection between line *BA* and the 50 per cent horsepower output ordinate.

With the 30-hp. motor used as an example the full-load current rating is 38 amperes, and the measured idle current is 12 amperes. Therefore, *OB* is 6 amperes. Curve *DCA* may be constructed and any horsepower output may be determined by measuring the line amperes corresponding to that particular load. If the ammeter reading is 44 amperes, say, it corresponds to 34.6 hp. on the constructed curve *DCA*, whereas actually the load at this current value is 35 hp., as determined from the factory test data curve. If a wattmeter were used to measure the input and the efficiency were assumed, it would be difficult to obtain higher accuracy than the 1 per cent given by the ammeter method.

This same procedure can be carried out similarly in estimating the horsepower output of direct-current and slip-ring motors.

•

Testing 120-Cycle Equipment

C. O. VON DANNENBERG
Brooklyn, N. Y.

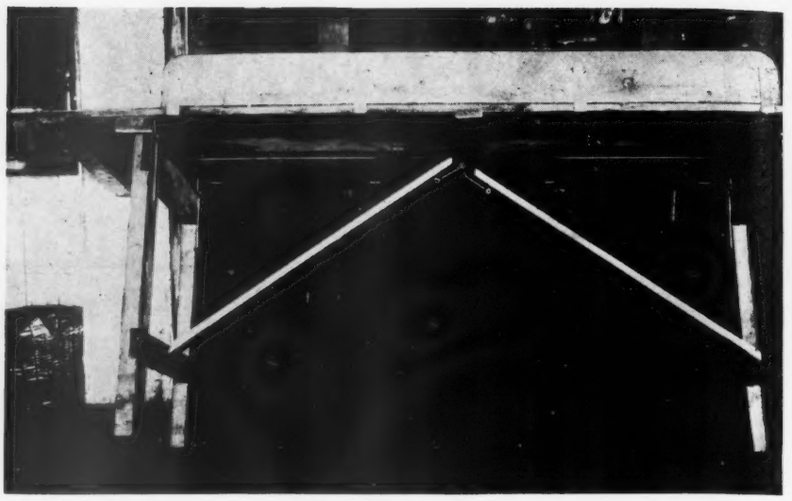
The article by M. M. Rose, June issue, page 286, recalled the methods that were used in testing 120-cycle equipment when only 60-cycle service was available.

It was necessary to test some single-phase 2,200-volt transformers and three-phase motors. There was available a 100-hp., 220-volt, three-phase, slip-ring-type motor which was used as an induction generator.

It is well known that when an induction motor is at rest, with normal voltage and frequency impressed on the stator, voltage with a frequency of 60 cycles will be induced in the rotor. Revolving the rotor in the opposite direction to its normal rotation will result in an increase in the frequency of the induced current so that at synchronous speed in the reverse direction the frequency will be 120 cycles. This principle was used in obtaining curent for the equipment referred to. The correct voltage for testing was obtained by stepping the current up through transformers and adjusting it by varying the voltage on the stator by means of a variable-tap bank.

It is also possible to obtain 25-cycle energy in a similar way from the rotor by driving it in its normal direction at 25/60 or 41.6 per cent of its normal speed.

A slip-ring motor used to obtain different frequencies is best driven by direct-current supplied from a motor-generator set or other source of direct current. Obtaining the desired speed is then a simple matter.



Folding Bench

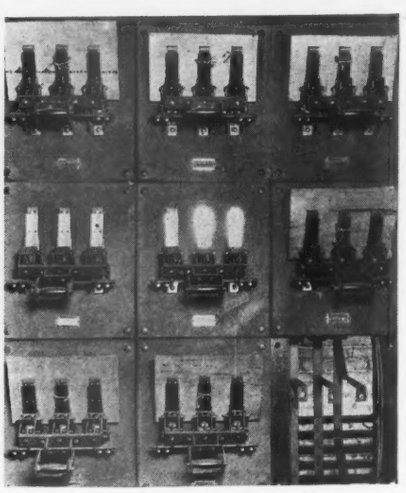
Sometimes our punch presses are running on coil stock, sometimes on strip. When the latter is being used, some sort of sturdy bench is needed to hold it—preferably a bench which can be folded up and stored out of the way when not in use.

Hence the bench illustrated. Note its heavy construction. Top and side boards are covered with sheet iron. The legs swing inward on heavy T-hinges. Each leg has a strut hinged to it, and the struts are hooked to a center reinforcing strip when the table is opened for use.

•

No Careless Closing Of These Breakers

Red tags are good things to guard against unauthorized closing of switches and breakers but better things are means actually to prevent such closing. At the plant of the Crane Company in Chicago a very simple device is used to hold breakers open. As illustrated it consists of a piece of plywood board placed between the breaker contacts and tied with a string to the center leg. No chance for a day-dreaming operator or one flustered by an emergency to close a breaker so protected.



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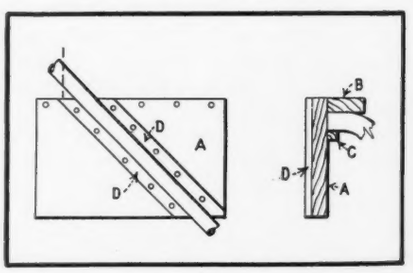
To Angle-Saw Tubing

JOHN E. HYLER, Peoria, Ill.



By using a special pair of false jaws for the vise, the tubing will be so held that a simple plumb cut will produce the angle desired.

Pieces *A*, *B* and *C* are of wood. Pieces *D* are of metal and are attached to *A* at 45 deg. from *B* and *C*, and just far enough apart for an easy push to nest the pipe or tubing to be cut. Only one of the false jaws is shown in the illustration.

•

Finding Leaks In the Water System

SHEVILLE LEULLOFF
Hamilton, Ont., Canada

Some time ago while studying water consumption in the various departments of the plant we discovered leaks in the water distribution that had previously been unsuspected.

Leaks were detected by means of an integrating, 2-in. water meter placed in each line in turn. A feeder line would

be opened and the meter inserted; upon shutting down for the night the line was checked to make sure no water was being drawn by seeing that all valves were closed. Before starting operation next morning the meter was read again. If a line was leaking the meter disclosed that fact, along with the amount wasted, in gallons.

We found this method of checking water leaks simple and effective, and were able to reduce the water bill considerably.

•

Putting a Wire-Tier In the Production Line

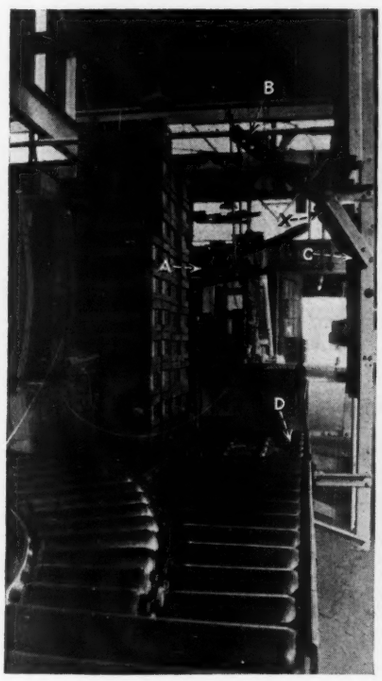
J. C. Watson, Master Mechanic
Franklin Tile Company, Lansdale, Pa.

Adoption of wood boxes, crates, and some cartons of different sizes presented the problem of wiring these packages rapidly and economically. The combination of a wire-tying machine with a special, ball-bearing gravity roller conveyor shown in the illustration was eventually worked out. The two views show opposite sides of the tying machine. In the view at the right the machine is shown in position for tying a box.

The frame for supporting the tying machine, *A*, is built of angle iron fastened to the bottom of the gravity conveyor so that it and the machine can be moved as a unit when the production line is changed. Two rods were brazed to the machine, slightly off the center of gravity, and holes drilled in the ends of the suspension arms, *B*, for the rods to pass through. The machine is balanced by a counterweight, *C*, and is placed so that the wire comes just over the edge of the conveyor, which allows it to be wrapped around the crate or box without interference.

To make the machine stable in any position a small brake is attached to the suspension arm at *X*. By loosening a thumbscrew the machine may be removed for repairs.

The crates are wired about 5 inches from each end, so that each one must be turned end-for-end to put the wire on. Means for doing this were provided by replacing several rolls in the gravity conveyor with a plate, *D*, containing a number of roller casters.

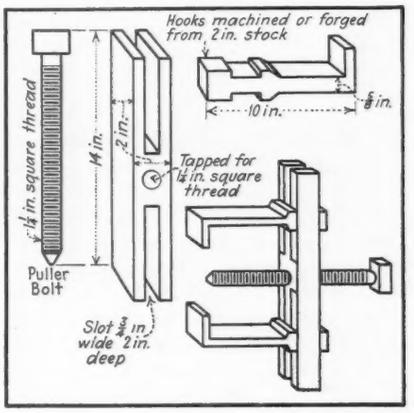


SPECIAL NOTICE

$10 will be paid for the best Maintenance Short submitted by the 15th of September. The Editors are the judges. Other Shorts accepted will be paid for at attractive rates

Non-Slip Pinion Remover

W. B. Cone, Chief Electrician
The Shevlin-Hixon Company
Bend, Ore.



The illustration shows the construction details of a pulley, gear and pinion remover which has the advantage of being rigid, so that the arms will not spread or slip when under a pulling strain. Most of the designs of pullers have a tendency to slip, which is highly objectionable.

In the type shown the hooks may be of any length, but the size shown will take care of most jobs and is not too heavy for one man to handle.

•

Electric Heater Keeps Temperature Constant

At the Brunswick - Balke - Collender Company in Muskegon, Mich., it is necessary to maintain a temperature of 100 degrees F. in a special testing room, 16x20 ft., with an 8-ft. ceiling. One wall is of 8-in. brick, the remaining three walls and ceiling of ¾-in. boards on one side of 2x4 studding, ½-in. Celotex plus ¾-in. boards on the other. The allowable variation in heating the room is not more than one degree. To meet the foregoing specifications and to maintain 100 degrees F., a combination of an electric fan and steam coils to supply and circulate the heat was first installed. This method proved to be not altogether satisfactory because of variations in steam pressure which could not be compensated for even by the use of a sensitive thermostat to control the steam flow.

The steam apparatus was, therefore, removed and replaced by a 4½-kw. electric heater. With the fan allowed to run continuously, the same thermostat as used before has been reconnected to control the electric heating elements directly. . The room's temperature is now being held within the very close limits of the one degree specified.

QUESTIONS and ANSWERS

Conducted by G. A. VAN BRUNT

Why Do These Motors Heat?

We have three 2-hp., 1,800/1,200/900/600 r.p.m., 220-volt, three-phase, 60-cycle, multi-speed squirrel-cage induction motors driving three conveyors. These conveyors must all operate simultaneously and at the same rates of travel, corresponding to the four motor speeds given above. One drum controller was installed for the three motors, with one set of fourteen No. 8 wires, the connections to the motors being taken off at each location, which are about 100 feet apart. The motors operate satisfactorily at two speeds, but heat up badly at the other two speeds. All connections have been checked for correctness, there are no shorts or grounds, and the motors are not overloaded. Can anyone explain the cause of this trouble and how to correct it. *E.M.—Brooklyn, N. Y.*

SOME motors of the multi-speed, squirrel-cage induction type maintain constant horsepower output, irrespective of the speed. In order to obtain this characteristic the torque must change inversely with the speed. Other motors of this type develop constant torque at each speed; hence, as the speed increases the horsepower output increases. Sometimes these considerations are overlooked when applying motors to loads that require different speeds.

Assuming that the torque of the conveyor load remains practically constant for all speeds, as the speed is increased the load becomes heavier. As a result it may be presumed that the motors are overloaded at the higher speeds and consequently become hot, although they are not overloaded at the lower speeds.

Unless the motors can be relieved of their overload there is no remedy for the severe heating, except replacement with a larger size motor. J. L. YOUNG
St. Marys, Ohio

Raising Generator Voltage

Current for our plating tanks is supplied by a 6-volt, 200-amp., 1,200-r.p.m., direct-current generator. Now we want to use another plating solution that requires a voltage of 7.5 to 8 volts. Is there any way of raising the voltage delivered by our generator without rewinding it? *A.D.F.—Chicago*

IF THE generator is self-excited it will probably be impossible to increase the voltage beyond its normal value. By separately exciting the field, the maximum value to which the voltage can be raised can readily be determined, care being taken not to overheat the fields.

This is simply one possible method, since generators of this type are usually very stable, without much range in voltage control. It is sometimes possible to vary the voltage by shifting the brushes, although sparking may result.

The capacity of this generator is so small that separate excitation can probably be obtained by means of a dry-type rectifier with resistance, assuming that only alternating current is available. It would be desirable to measure the current in the field circuit during a test, which should be prolonged sufficiently to cover the plating period, if the heating of the field is to be obtained.

If a test indicates that sufficient voltage increase cannot be obtained, it will be necessary either to rewind the armature or purchase a new generator.

C. O. VON DANNENBERG
Brooklyn, N. Y.

THERE are three possible ways of increasing the generator voltage: (1) Increasing the field current; (2) increasing the field strength by shimming the polepieces; (3) increasing the armature speed.

If the generator is separately excited it should not be difficult to increase the field current. In case the machine is self-excited provision can be made to excite it from a rectifier or small generator. The possible increase in field current will depend on the heating effect and the magnetic saturation.

The temperature of the field coils should not be allowed to rise above 80

(Continued on advertising page 76)

ANSWERS WANTED

Cleaning Antifriction Bearings

Is it absolutely necessary to flush out ball and roller bearings in motors, lineshafts, and machines, that are lubricated from two to four times a year? If it is necessary to wash them out, how often should it be done? What is the best liquid to use? Are there any precautions that must be observed?
A.P.—New York

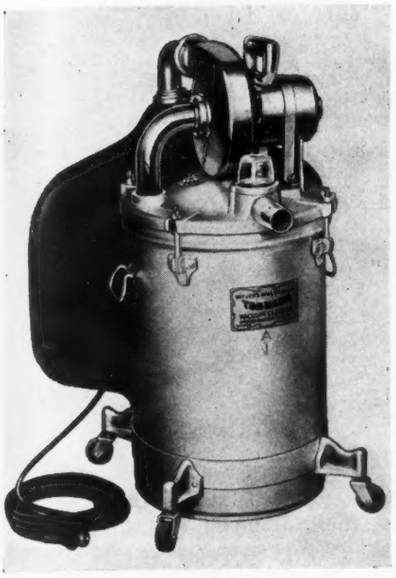
Measuring Temperature of Motor Coils

I wish someone would outline the best practical method of determining the temperature of motor and other coils at the hottest point. I understand that a thermometer attached to the outside of the coils will not give the true temperature of the interior of the coils. I should like to know whether there is any way of measuring it. If not, can it be estimated with reasonable accuracy?
M.D.—Baltimore, Md.

Why Do Holding Coils Burn Out?

Burning out of the holding coils of two 440-volt, three-phase magnetic switches has caused us much trouble recently. These switches, which are rated 15 and 25 hp., respectively, are several years old, but gave us no trouble until about a year ago. Then the coil in one switch burned out suddenly. Shortly after it was replaced the coil in the other switch failed. Each coil has burned out two or three times since then. These switches have been carefully inspected and are in good condition. They seem to operate properly until the coils burn out. The only unusual action I can notice is that sometimes these switches hum. What is the cause of these burn-outs, and how can I prevent them? *A.K.E.—St. Louis, Mo.*

·EQUIPMENT NEWS·



Vacuum Cleaner

Heavy-duty, industrial. Model 112 Tornado. Has 1-hp. ball-bearing motor, 46¼-in. waterlift, 12-gal. steel tank, complete set of standard attachments for all plant cleaning purposes. Weighs 45 lb. Observation glass allows operator to see dirt being removed when cleaning. Motor unit removable for use as blower. Special tools for cleaning furnaces, boilers, ovens, flues, boiler tubes. Breuer Electric Mfg. Co., 852 Blackhawk St., Chicago.

Cap Screw

Knurled, socket head. Called "Unbrako." Knurled head claimed by manufacturer to provide plier or finger grip which enables faster driving. Socket head for final wrench tightening. Same quality as old smooth head cap screw. Standard Pressed Steel Co., Jenkintown, Pa.

Valve

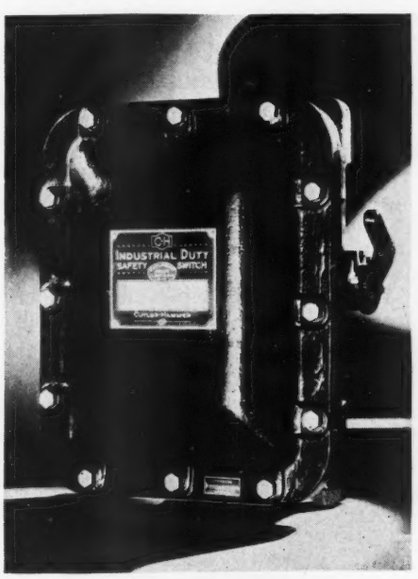
"Freeze-Proof." For regulating temperatures of brine-cooled refrigeration systems, cold storage rooms, refrigerator boxes, drinking water cooling systems, etc. Designed to prevent frost from forming on valve stem and entering stuffing box. Has metal housing that incloses valve stem and packing nut, inclosure being filled with asbestos saturated with ammonia compressor oil. Claimed to work freely when subjected to temperatures as low as 70 deg. below zero. Fulton Sylphon Co., Knoxville, Tenn.

Welder

Close-coupled, gas-engine-driven, "Shield-Arc." Capacity, 300 amp., 40 volts. More compact, lighter than previous models. Supplied mounted on rigid steel base with totally inclosed steel side curtains. May be mounted on small factory portable steel wheels or 6-in. face steel wheels for outside use. Has dual control of welding heat, sparkless commutation, arc-welded steel construction. "Lincontrol," remote current-control device, optional equipment. The Lincoln Electric Co., Cleveland.

Switches

Explosion-proof, safety, for use for Class I, Group D, hazardous locations. Both single-throw and double-throw in standard sizes up to 200-amp. capacity. Heavy, industrial-duty, Type A construction, with outside-operating handle, mounted in heavy weather-proof, semi-steel cast inclosure. Provision for padlocking handle in either position, three



padlocks on either position. Finish, black Japan. Cutler-Hammer, Inc., Milwaukee.

Compressors—Exhausters

Centrifugal, single-stage, Type "OIB." Machines have own shafts and bearings and are suitable for direct connection to standard electric motors or steam turbines without special shaft extensions. Also adaptable to V-belt or flat-belt drive. Impellers furnished in aluminum or carbon steel, or special alloys where required. Open-type impellers on smaller sizes, closed type on larger. Casings ordinarily are cast iron, special alloys supplied on order. Antifriction bearings on smaller, sleeve bearings on larger sizes. Roots-Connersville Blower Corp., Connersville, Ind.

Soldering Outfit

Prest-O-Lite "4-in-1." Like "5-in-1" outfit but has only four stems, omitting soldering iron. Four stems cover: fine soldering for toy manufacture, telephone repairs, heating operations on delicate instruments; light soldering, brazing, and heating, as in soldering wire splices; medium soldering, brazing, and heating, for average open-flame work; and heavy soldering where torch must furnish large volume of heat sufficient for bending rods, and so forth.

Also two Prest-O-Lite Plumbers' outfits for soldering copper piping installations, designed specifically for installing new-type copper pipe fittings. No. 1 has torch with needle valve, 15 ft. of hose, and 5-lb. pressure regulator, No. 2 has torch and extra stem, 15 ft. of hose, and tank union. The Linde Air Products Co., 30 E. 42nd St., New York.

Grinder

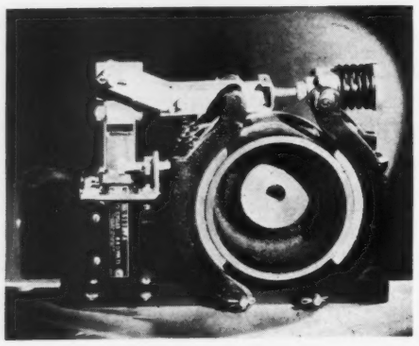
Portable, electric, light-duty. Body and handle of cast aluminum. Weight, 9 lb.; length, 14⅜ in.; diameter 4 in. Universal motor, rated 110 volts, 25 to 60 cycles, 1.5 amp. Speed, no load, 3,400 r.p.m. Positive "make and break" toggle switch. Brushes accessible from outside. Equipped with 8 ft. of heavy-duty rubber-covered cord, rubber plug, and 4-in. general-purpose grinding wheel. Bearings are bronze, wool packed with thrust ball bearing on shaft wheel. Heat-treated alloy gears. Signal Electric Mfg. Co., Menominee, Mich.

Welding Electrode

Heavily coated, general-purpose, for welding with shielded arc on mild steel. Designed particularly for high-speed and single-pass welding. Called "Fleetweld No. 7." Claimed particularly suitable for welds where fit-up is apt to be poor. Said to have high burn-off rate, low splatter loss, and give smooth finished bead. Weld metal characteristics as follows: tensile strength, 70,000 to 80,000 lb. per sq.in.; yield point, 55,000 to 60.000 lb. per sq.in.; ductility, approximately 20 per cent elongation in

2 in.; resistance to corrosion greater than that of mild steel. Supplied in diameters of $\frac{1}{8}$, $\frac{5}{32}$, $\frac{3}{16}$, $\frac{7}{32}$, $\frac{1}{4}$, $\frac{5}{16}$, and $\frac{3}{8}$ in., all 14-in. lengths. The Lincoln Electric Co., Cleveland.

Brakes



Small, a.c. and d.c., solenoid-operated. Three sizes with torque ratings from 3 lb. ft. to 75 lb. ft. Large brake wheel. Dimensions of a.c. and d.c. brakes interchangeable. Brake shoes use molded brake lining and provide 180-deg. braking service. Cutler-Hammer, Inc., Milwaukee.

Explosives

American Cyanamid & Chemical Corp., 30 Rockefeller Plaza, New York, announces acquisition of plant, properties, and business of Burton Explosives, Inc., Cleveland. Burton plant at New Castle, Pa., will be operated as Burton Explosives Division of American Cyanamid.

Air Conditioners

Gas-operated. Two units, one room unit for dehumidifying and cooling, other, for basement mounting, consists of gas heating unit arranged for simultaneous warming of water and air to give humidistat-controlled, automatically maintained humidity in factory or office. The Bryant Heater Co., Cleveland.

Acetylene Generator

Automatic, stationary, known as Oxweld Type MP-5. Rated to deliver 1,000 cu.ft. of acetylene per hr. Resembles Oxweld Type MP-4 portable generator and is identical in principle except for slight changes to fit stationary use. The Linde Air Products Co., 30 E. 42nd St., New York.

Pipe Welding Fixture

Capable of handling all sizes of pipe up to 12-in. diameter. Claimed to line up accurately and hold in position for tacking fittings, flanges, and branches at any angle. Extension bench can be supplied for handling longer lengths. Extension can be moved to any angle to main bench. Adjustable elevator controls vertical alignment of work at any position on bench or extension. Bench and extension consist of eyebeam mounted on tubular legs with spread to eliminate danger of tipping. Bench weighs 700 lb., extension 300 lb. Bench readily disassembled for portability. Dimensions of main bench eyebeam, 8 ft. long, 1 ft. wide; extension 6 ft. long, 1 ft. wide. Height of each, 2 ft. Oster-Williams, Cleveland.

Waterproofing

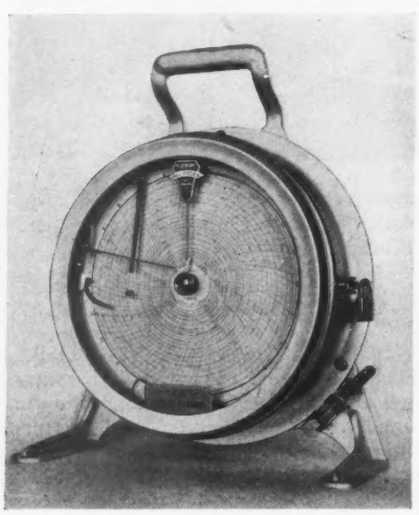
Called "Stonhard Stontite." Liquid material for stopping leaks in concrete walls, floors, foundations, elevator pits, tunnels, or other concrete construction. Unnecessary to remove hydrostatic pressure. Material is used on free or open side. Stonhard Co., 401 N. Broad St., Philadelphia.

Valve

Heavy standard, bronze, gate. Designed for 150-lb. working steam pressure and 250-lb. working water, oil, or gas pressure. Known as Fig. 23. Has all special features of Fig. 27 valve, but is heavier throughout to withstand higher working pressure. Complete range of sizes up to 3 in. Kennedy Valve Manufacturing Co., Elmira, N. Y.

Instruments

Portable, recording. Furnished with either self-contained or long-distance type thermometers in 8- or 10-in. case sizes. Chart disk removable without use of screwdriver. Soft, frosted silver finish, or dull black lacquer. Also companion instrument, with identical features, for recording pressures. Either instrument can be removed from stand and fastened on wall or board for permanent use. The Foxboro Co., Foxboro, Mass.



Motor Starter

Automatic. Claimed positively to prevent accidental starting and permit taking full advantage of motor's capacity without danger of burning out. Across-the-line type. Has red stop button extending around and beyond green start button so that bump or accidental touch of control moves only stop button. Inverse time limit protection allows carrying small overload long time or heavy load short time. Furnished in three types for various horsepowers and 110, 220, 440, and 550 volts. The Lincoln Electric Co., Cleveland.

Meter

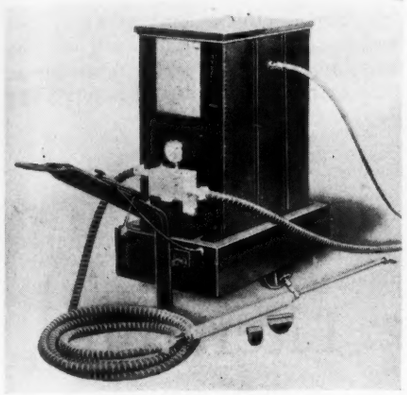
Long distance transmitting and recording. Operates on "chrono-flo" system. Consists of transmitter, recording receiver, relay and rectifier box at the receiver, and two-wire line connecting transmitter and receiver. Permits records of temperature, pressure, liquid level or motion to be transmitted 250 miles or more with accuracy and freedom from circuit disturbances. Called "Metameter." Transmitting element detects measurement and translates it into time function. Receiver translates time function back into movement of pen to record measurement as detected at source. System requires source of alternating current at both receiver and transmitter, not necessarily synchronized or of same frequency. Recording receiver uses 12-in. chart, is housed in moisture-proof case. The Bristol Co., Waterbury, Conn.

Clutches

Compression, sleeve, with asbestos friction. Series 5 and 6. For material-handling machinery, to "make and break" on hoists, winches, drums, brakes, cable. Have full-floating fric-

tion, non-burning contact, drop-forged actuators, steel carrier, simple, accessible adjustment, renewable friction lining. Conway Clutch Co., 1543 Queen City Ave., Cincinnati.

Spray Cleaner



Called "Fireless Hypressure Jenny." Portable, 20 in. wide, 45 in. high, and 52 in. long, including handle. Differs chiefly from other models in that it uses plant steam instead of producing its vapor by means of oil-fired generator. Unit consists of water or solution tank containing automatic float level valve, rotary pump directly connected to and driven by fractional horsepower motor operated from light socket. Manually adjustable mechanism permits amount of compound and moisture content to be varied by operator, and full nozzle control is obtained by means of valve on gun. Operates over range of pressure from 50 to 250 lb. Manufacturer claims product does not require licensed operator or boiler inspection. Homestead Valve Manufacturing Co., Coraopolis, Pa.

Union

Cold forged, with two silicon bronze seat rings. Heavy-duty construction. Ring seats claimed by manufacturer to resist corrosion, withstand electrolytic action, permit repeated "make-up" and "break-apart." Suitable for requirements up to 500 lb. working steam pressure and 700 deg. F. Sizes $\frac{1}{8}$ to 3 in. Also male and female unions in sizes from $\frac{1}{4}$ to 2 in. Rockwood Sprinkler Co., Worcester, Mass.

Conveyor Belt

Hot-material. Employs principle of heat resistance used in Golden Ply tires. Claimed by manufacturer to have 85 per cent greater flexing life in new construction than regular grades of hot-material belting, and to have cover offering greater resistance to abrasion after prolonged exposure to heat. The B. F. Goodrich Co., Akron, Ohio.

Wheels

Industrial. Designed to replace steel wheels on equipment already in service. Known as "Vulc-On." Available in assortment of sizes and types. Consists of rubber tire permanently bonded to one-piece steel wheel with standard, cage-type, anti-friction roller bearings. Standard lubrication fittings provided for. Claimed by manufacturer to reduce wear on floors, roll easily, lower depreciation on equipment, reduce noise and breakage. The B. F. Goodrich Co., Akron, Ohio.

Fire Brick

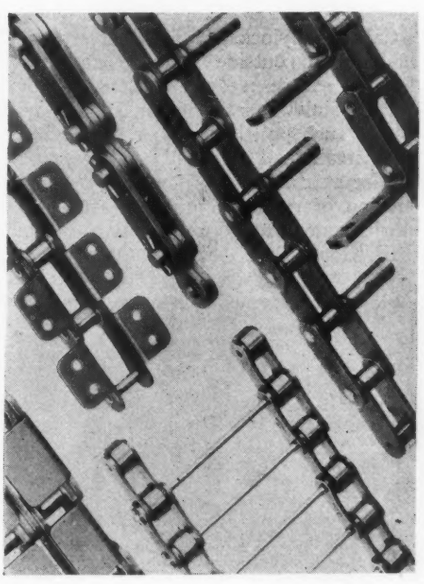
Insulating. Called G-25. Manufacturer claims these bricks capable of cutting fuel costs as much as 50 per cent. Physical characteristics include: density per cu.ft., 42 lb.; cold crushing strength, 220 lb. per sq.in.; hot load panel test, 8 lb. per sq.in. at 2,500 deg. F.—no deformation. Recommended for use in oil-, gas- and electric-fired furnaces for temperatures up to 2,500 deg. F., where slagging or severe abrasion is not encountered. A. P. Green Fire Brick Co., Mexico, Mo.

Chain Drive

Silent. Called "Silverstreak." Is previous product in "new dress." Chain is blued, washers and guide bars silvered for improved appearance. No claims for improved efficiency, strength or durability made. Link-Belt Co., 910 S. Michigan Ave., Chicago.

Conveyor Chains

Four sizes and two types, with standard and over-size rolls. Employ standard roller chain construction with extended pitch, and permit application of attachments that can be bent, welded, or riveted to fit wide variety of applications. The Whitney Manufacturing Co., Hartford, Conn.



Floor

Slip-proof, steel. Called "Safety-Tred." Claimed to assure safe footing from any angle of approach, and to be practically indestructible. Furnished as blocks, planks, or plates. Adapted for floors in buildings, runways, shipping platforms, railroad crossings, cat-walks, stairs, ramps, cover plates, and boiler rooms. May be used for patching or resurfacing wood, block, or concrete floors. Truscon Steel Co., 6101 Truscon Ave., Cleveland.

Outlets

Prelocated, for underfloor duct. Called "Prelokaylets." Designed to provide greater facility in location of concealed outlets. Have adjustable nipples set flush with top of concrete and provided with brass caps containing magnetic pin, or with steel caps. Pins are located by four-compass magnetic finder, steel caps by meter finder plugged into 110-volt circuit. Outlets may be clamped on at any point along line of duct on job, or set at factory at specified spacing. General Electric Co., Schenectady, N. Y.

Drill Grinder

Self-contained, bench-type, with built-in motor, push-button control, and Alemite lubrication. For sharpening drills of from $\frac{1}{16}$- to $1\frac{1}{2}$-in. diameter. Called 05D. Has drill-holding chuck designed to hold even delicate drills and clamp with one-quarter turn of knob. Weighs 110 lb., occupies 16x13-in. bench space, is 12 in. high. William Sellers & Co., Inc., 1600 Hamilton St., Philadelphia.

Fuse Cutout

Porcelain-inclosed, indicating, and drop-out. Gives positive evidence that circuit is open. Rated at 5,000 volts, 60 amp., with interrupting capacity of 1,500 amp. Convertible from indicating action to drop-out action by removing with fingers small wire yoke from mechanism. Designated as Catalog No. 9F6A1. General Electric Co., Schenectady, N. Y.

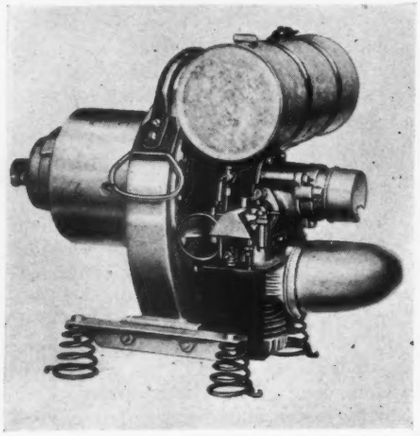
Bushings

Now furnished to A.S.A. standards for drill sizes from $\frac{1}{16}$ to and including $1\frac{3}{4}$ in. diameter, in nine groups or outside diameters for head and headless press fit bushings as against seven groups in previous standard. Renewable bushings and liners in first seven groups as in past. Old standard bush-

ings will be carried in stock for reasonable time as replacements. Ex-Cell-O Aircraft & Tool Corp., 1200 Oakman Blvd., Detroit.

Floodlighting System

Portable. Can be carried by one man. Includes 1,250-watt generator weighing 89 lb. complete with built-in, air-cooled gasoline engine. Fully automatic, weatherproof, and dustproof. For



emergency outdoor use on repairs or construction. In daytime generator may be used to operate portable electric tools. Homelite Corp., 61 Riverdale Ave., Port Chester, N. Y.

Sprinkler Supervisor

For all dry-pipe systems. Designed to prevent freeze-ups. Automatic. Consists of air pressure switch installed on sprinkler valve, and supervisory panel installed in superintendent's office or where desired. Gives low air pressure warning that continues until condition is corrected. Warns by vibrating bell and glow lamp. Switch permits silencing bell when alarm is noted. Rockwood Sprinkler Co., Worcester, Mass.

Bar Stock

Permite Leaded Phosphor Bronze. Available in standard 6-ft. lengths in diameters from $\frac{5}{8}$ to 2 in., by $\frac{1}{16}$-in. steps. All standard bearing bronze alloys may be supplied. Has turned finish. For production manufacture of special bearings, bushings, fittings and small parts. Aluminum Industries, Inc., Cincinnati.

Ventilator

Portable, for use especially in removing welding fumes from inclosed compartments. Compact design. Can be lowered through a 14-in. diameter opening. Weight, including electric motor, 80 lb. Eight inch diameter flexible tubing may be used to carry off fumes and foul air at rate of 1,500 cu.ft. of air per min. In vertical position, ventilator rests on ring attached to inlet so that fumes are removed from lowest point. Coppus Engineering Corp., Worcester, Mass.

A.C. Regulator

Manual. Kathetron. For control of voltage below or above normal. Claimed to have flexible distant control with small losses at low voltage, accurate setting independent of load, practically unlimited life except for electronic tube with average life of 5,000 operating hours. Roller-Smith Co., 233 Broadway, New York.

Unit Heaters

Improvements in Series 3 line include redesign of cabinet for better appearance, use of streamline tubes, fins, and resilient motor mountings to eliminate resonance and isolate vibration, and use of header tanks with integral baffles to assure even steam distribution throughout element. Fedders Manufacturing Co., Buffalo, N. Y.

Surface Protection

Called "Protection." Comprises pigment vehicle, claimed by manufacturer to penetrate and seal all microscopic pits in surfaces, preventing entry of moisture and other destructive elements, thereby prolonging life of treated surface. Available colors are: clear, aluminum, black, light tan, khaki, and brown. Protection Products Co., Kalamazoo, Mich.

Endless Belt Joint

Called "Plylock." Said to overcome tendency of outside seam to open up during severe service. Consists of counter-sinking seam below surface of belt in such position as to relieve seam from strain and shield it from wear or windage. Seam is protected by thick cushion of rubber reinforced with bias fabric vulcanized into position. The B. F. Goodrich Co., Akron, Ohio.

Pipe Tools

Reamer and dies. No. 200 swivel type reamer, for $\frac{1}{8}$- to 2-in. pipe has malleable iron handle, heat-treated, alloy steel head that can be resharpened repeatedly and replaced when worn out. No. 70 and No. 72 series die heads, claimed not to mar pipe. Fully adjustable, have die throw-out, segmental dies, no loose bushings. Each set of dies threads two sizes of pipe. Available as plain or ratchet. Called "Beaver." The Borden Co., Warren, Ohio.

Trade Literature

ABRASIVE WHEELS—Booklet, "High Speed Abrasive Wheels Bonded with Bakelite Resinol."—Bakelite Corp., River Road, Bound Brook, N. J.

ACETYLENE FLAME—Booklet, "101 Uses for the Air Acetylene Flame."—The Linde Air Products Co., 30 E. 42nd St., New York.

BALANCES—Catalog 240, "Precision Balances for Weighing, also for Determination of Surface Tension, Specific Gravity, and Many Other Values."—Roller-Smith Co., 233 Broadway, New York.

BEARINGS—Catalog No. 12, covers Shafer Roller Bearings and Self-Aligning Units.—Shafer Bearing Corp., 6501-99 W. Grand Ave., Chicago.

BEARINGS—Catalog, on Bantam Antifriction Bearings. Contains engineering section on design, materials, and lubrication.—Bantam Ball Bearing Co., South Bend, Ind.

COMPRESSORS—Bulletin L-611-B3, Steam Booster Compressors.—Worthington Pump & Machinery Corp., Harrison, N. J.

CONVEYORS—Catalog, 16 pages, "Redler Continuous Flow Conveyors."—Stephens-Adamson Mfg. Co., Aurora, Ill.

DIESEL ENGINES—Bulletin S-500-B5B, Vertical Four-Cycle, Direct Injection, Type B.—Worthington Pump & Machinery Corp., Harrison, N. J.

DRIVES—Catalog No. 160, describes, illustrates, Dayton V-Flat Drives.—The Dayton Rubber Mfg. Co., Dayton, Ohio.

ENGINES—Six Bulletins, No. 51 to 55 inclusive, and No. 58, describe full line of De La Vergne Diesel engines.—De La Vergne Engine Co., Philadelphia.

GEARS, SPEED REDUCERS—Catalog No. 137, "Continuous-Tooth Herring-bone Speed Reducers and Gears."—D. O. James Mfg. Co., 1120 W. Monroe St., Chicago.

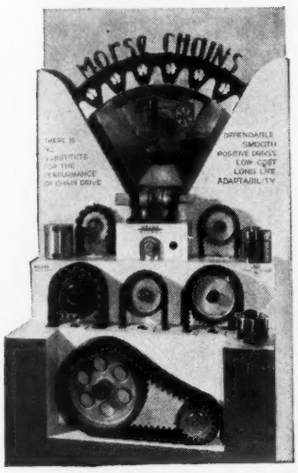
GENERATING SETS—Bulletin No. 107, "Troy-Engberg Generating Sets, Built to Save."—Troy Engine and Machine Co., Troy, Pa.

(Continued on advertising page 80)

POWER TRANSMISSION NEWS

In all their shining glory you will find Morse silent and roller chains, clutches and Morflex couplings on display and in action at the Century of Progress in Chicago.

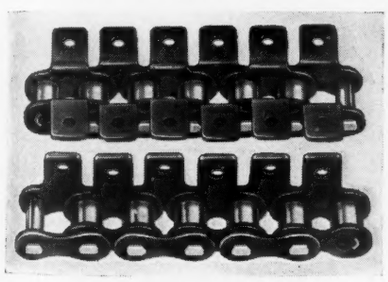
Light and action and working demonstrations all contribute to the interest of this elaborate exhibit, which is part of the complete Borg-Warner display.



We believe that, like thousands of others, you will feel that a visit of inspection to this display will be well worth your while. Be our guest.

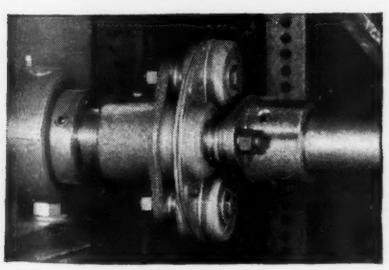
Roller Chains Standard Attachments

For use as conveyors, Morse Roller Chains are equipped with standard attachments which can be fitted to either side of the chain, or both sides.



Morflex Couplings

Shock and vibration, angular and parallel misalignments of shafts are "meat" for



the Morflex coupling, developed by the Morse Chain Co., Ithaca, N. Y.

The secret of its extreme flexibility without power loss is the especially developed, resilient, non-cold-flow, live rubber blocks. They have great resistance to deterioration. Because of the absence of friction and heat generation, tests have shown negligible power loss in this coupling.

The floating center reduces the effect of angular or parallel misalignment and the live rubber cushions uneven impulses, sudden reversal and vibration.

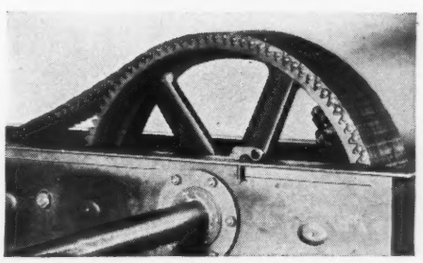
Add to these advantages the facts that no lubrication is ever required, no protection is needed against dirt, grit, water or weather, that there is no wear, no noise, no back lash, low cost, and you have many good reasons for its tremendous success in a multitude of services.

The Morse Morflex coupling, to be absolutely frank with you, simplifies the problem of 100% power transmission where shaft misalignment is encountered. There are many bores immediately available for use.

Morflex couplings with bores from 3/8" to 2 7/8" are carried in stock.

...REWARD!

WE WILL PAY THE PERSON SENDING A PHOTO OF THE OLDEST MORSE CHAIN IN OPERATION $25.00



We are continually hearing about Morse Silent Chains that have been in satisfactory operation for upwards of twenty years.

We want to find the oldest one, and we are willing to pay for it. Perhaps you have a Morse Chain in your plant that would qualify. Send along a picture of the installation. If it's the oldest we receive, you will get a check for $25.00. Write a short statement about the work it performs.

Photos must be in by November 1st. In the event of a tie, prizes of equal value will be awarded.

MORSE CHAIN COMPANY

A Division of Borg-Warner Corporation

ITHACA, NEW YORK

ADVERTISEMENT—*Each item on this page is a paid advertisement*

WINTER IS COMING:

Make Sure Your Plant Will Be WARM

CHROMALOX UNIT HEATER—TYPE HF

For Operation on 115 or 230 Volts 60 Cycles A. C. 6 sizes, 1.5 Kw. to 4.5 Kw. complete with automatic temperature control.

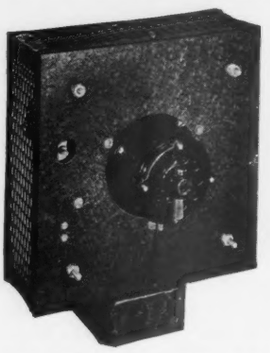
Now while it is a pleasant task, we suggest that you list these cold spots, and start your investigation of how to heat them effectively with electric heat, before cold weather pushes you to install makeshift provision for the winter.

Consider your electric fan, while you list these spots, for in many ways it parallels electric heat. It costs you nothing while it is not running, very little while it is keeping you cool. It requires practically no attention, does not leak, involves no installation expense for piping, valves or generating equipment. All you need do is aim it at you, plug it in, turn the switch.

● Chromalox electric heaters are very little different from your fans. They add only the electric heating unit to the fan for heat generation. Fan and heater plug in together. You set it up, plug it in and turn the switch. If you wish, a thermostat will turn the switch for you. And it will do the heating job with practically no attention, without any extension to your present heating system, at costs for current which you will find compare very favorably with your present costs for steam.

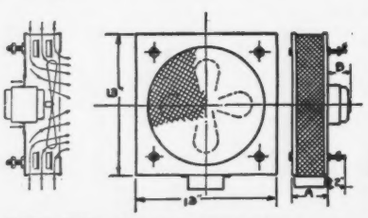
There is a Chromalox design of heater, with or without the fan or blower, for every possible heating requirement. There are Chromalox engineers ready to come to your plant to consult with you, to provide you figures in detail on each of your heating problems for each of those cold spots on your list.

To help you in your preliminary studies, there is a 60-page catalog of heating units and equipment—that is yours for the asking.



Rear View showing mounting bolts for attaching heater to either wall bracket or ceiling bracket. Only one electrical connection needed.

●



NOTE HOW AIR IS DRAWN IN from all four sides of the Chromalox Unit Heater—circulating a greater volume of heated air and producing more uniform temperature.

FREE 60 Page Book *of Electric Heat Data*

Write for the catalog, or the engineer or send your list of cold spots to us for our diagnosis. Do it now while your fan is keeping you cool the electric way just as the Chromalox heaters will economically keep your plant warm this winter.

CHROMALOX HEATING UNITS

Manufactured Exclusively by Edwin L. Wiegand Co.

7518 Thomas Boulevard ★ Pittsburgh, Pa.

Make an Investment of Production Planning

(Continued from editorial page 383)

Excessive system requirements are invariably found where the functions are not properly established or the calibre of personnel is insufficient to meet the demands of the task. A good planning manager can invariably produce splendid results with a relatively small staff. A system-hound will frequently attempt to replace highly necessary initiative with non-paying paper media.

"Push and Pull" Planning

Instead of the old, detailed planning method, it is believed that control over production in the future will be run to a greater extent along the generally known "Push and Pull" type of planning. This, as commonly understood, implies a scheduling of raw materials into manufacture. In cases of companies that manufacture a great many parts, it has been found satisfactory and sufficient to schedule through the fabricating operation and at this point to carefully reconcile the schedule of what was to be delivered with the amount actually produced.

The intermediate personnel and machinery requirements can be scheduled in total, with the results that much of planning work formerly considered necessary can be eliminated. It is not necessary to schedule the time of each and every individual working in a plant, but it certainly is possible to plan the personnel requirements in terms of a productive division for the week as a whole, and daily, without becoming completely involved as to individuals.

Such planning measures invariably decrease personnel waiting time while simultaneously giving a foreman latitude in the apportionment of work. The judicious nature of the individual foreman can readily be determined over a period of time by an analysis such as shown on the accompanying chart, covering employees' high, average, and low weekly earnings and annual earnings.

Some executives, in their discussions of system work, seem to try to justify an excessive amount of planning on the theory that all foremen are dummies. In my estimation foremen are the potential manufacturing executives of tomorrow. Certainly we shall have a moronic group of candidates for top positions, if the secondary group is given no latitude today. Foremen can be given a great deal of latitude in the development of their judgment without a loss of control over their activities. This is a factor which, because it has been overlooked so frequently in the past, has been a source of no small amount of labor difficulty and lack of understanding.

The foreman is the key man in the chain of administration and labor. He, in a great many cases, can make or break the plant morale.

If a foreman of a given department is told how many people he will require by day and for the week he most certainly will know how to lay out his personnel requirements to the best advantage. He knows the people who are most capable of turning out the jobs in hand, he frequently knows how everyone stands from the financial

45 YEARS

OF SERVICE TO INDUSTRY

"U. S." Rainbow Sheet Packing, during its 45 years of service to industry, has seen many imitators. Its color has been imitated; its name has been imitated—but none has succeeded in equaling its performance on the job.

Today, as in 1889, "U. S." Rainbow is the standard by which sheet packings are judged.

Made of a specially compounded heat-resisting composition of the proper firmness to hold in a joint without blowing or squeezing out under high pressure or temperature, it is of exactly the right resiliency to fill up irregularities and to absorb vibration, contraction and expansion in the line.

"U. S." Rainbow is the only Sheet Packing of this character that is recommended for saturated steam pressures up to 175 pounds.

Made in two styles: No. 9 for average steam, air and hydraulic joints; No. 19 brass wire inserted, for heavy service. Made in rolls, 36 inches wide, weighing from 100 to 200 pounds; standard thicknesses—1/32 inch, 1/16 inch, 3/32 inch, 1/8 inch, 3/16 inch and 1/4 inch.

United States Rubber Company

1790 BROADWAY NEW YORK CITY

STOCKS IN ALL INDUSTRIAL CENTERS

angle, and he has that little personal insight which quite frequently is lost with detailed planning methods.

Signs of favoritism can very definitely be checked by the management through the analysis of such factors as day work allowances, piece work allowances, and excessive amounts of work given to a certain favored group. The foreman will very soon learn that a company will not brook favoritism, consciously or unconsciously displayed by the foreman.

The objective in the planning methods of tomorrow will be to retain as much initiative as possible in foremen while simultaneously keeping down minimum wage allowances, reducing to a minimum the cost of planning, maintaining economic lot sizes, and the many other functions described as the duties of the planning division.

Tangible Effect of Proper Planning on Cost

By means of a proper analysis of payroll and an investigation of time studies, one can definitely estimate the savings that can be effected through a revision of planning methods. This function has a definite dollars and cents value to every company. The trouble is, in many instances, that the business-like aspects of the function have not been properly demonstrated.

In discussions with various industrialists I have been given to understand that it is not possible to obtain economical runs because of pressure placed for the reduction of inventory. Investigations of standard minimum ordering quantities, converted into dollars and cents and compared with the total inventory that the company carried, invariably disclosed tremendous differences. This is accounted for in many ways; for example, by obsolete stock, slow moving items, slip-ups in schedules. Frequently it is found that the inventory reduction desired by the financial side of the business can be obtained without reducing the ordinary run of production to a less than economic lot size.

Through this depression companies invariably have taken one of two courses. In one course, a "catch as catch can" sales policy has been followed which meant that a sales department tried to sell anything as long as it looked like some business. In the other course, companies realized the effect of reduced volume and threw their "cats and dogs" overboard in order to solidify on what they were or should be able to handle satisfactorily. In companies following the second course, one usually finds evidence of close cooperation among the cost, time-study, methods, engineering, and inspection functions. Those companies have come through the past few years with relative success.

Planning Division Incentive

There are many factors for the measurement of the effectiveness of planning. There is the delivery of performance of the factory in comparison with performance promised. Where the internal trucking and routing of material is under control of planning, there are measuring sticks such as the number of requisitions, the volume of parts and assemblies transferred, the number of trips made by various trucks.

The cost of clerical work can be definitely measured on the basis of number of transactions and credits made

ROOFING FAILURES NO. 8

THESE two roofs served under identical conditions. The pitch-and-felt roof was nine years old when the smooth-top roof was built. The pitch-and-felt roof is still fine, 16 years old and with years ahead of it. But the smooth-top roof cracked, leaked, ruined the insulation . . . and was taken off.

Why the difference? Simply this: Smooth-top roofings should never be placed on flat decks. This one *was* built on a flat deck. Water lay on it and the roofing disintegrated.

Roofers all over the country are now protesting against the use of anything but coal tar pitch on flat decks.

7 YEARS OLD . . . Ruined. A Smooth-Top Roof

These two roofs were on buildings almost side by side in Brooklyn.

16 YEARS OLD . . . Still Fine. Pitch and Felt Roof

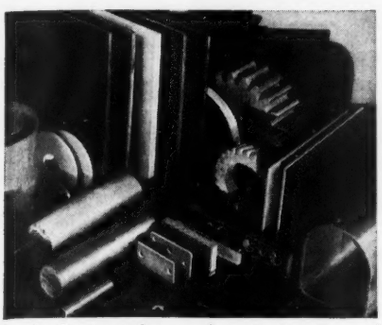
KOPPERS PRODUCTS COMPANY
KOPPERS BUILDING, PITTSBURGH
Birmingham Boston Chicago New York Providence St. Louis

- Koppers Coal Tar Pitch
- Koppers Tar Saturated Rag Felt

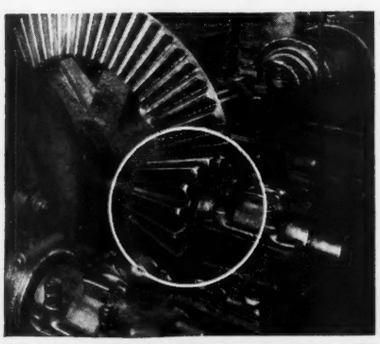
Other Koppers Products: Membrane Waterproofing; Dampproofing; Tar Aluminum Paints; Plaster Bond Paints; Tarmac Road Tar for Streets, Pavements, Drives, Highways.

NRA MEMBER U.S. WE DO OUR PART

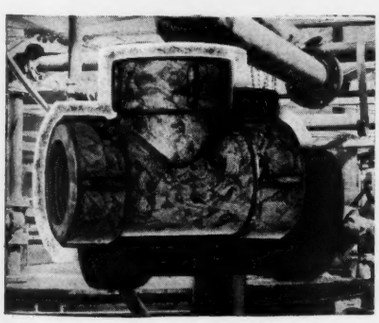
THESE MATERIALS keep down upkeep charges



Stock sheets, tubes and rods; gears and punchings of LAMICOID, *a Bakelite Laminated product. Courtesy of Mica Insulator Co., N.Y.*



Bevelled MICARTA *(Bakelite Laminated) pinion driving calendar rolls.*



Pipe fitting of Impact Bakelite Material. (right) Flexible Bakelite Laminated, with soft rubber sheet "sandwiched" between sheets of fabric base Bakelite Material Product of Synthane Corp., Oaks, Pa.

IN THE CASE of factory equipment, both electrical and mechanical, first cost may soon be forgotten but upkeep charges continue indefinitely. Using maintenance materials that stand up longer in service reduces annual upkeep costs for both labor and materials.

These are the types of upkeep economies that can be expected to result from a general use of Bakelite Materials for maintenance work. Whatever type of Bakelite Material may be required for the job in hand, laminated in sheets, rods, tubes, or gears; baking varnishes and enamels for coating or impregnation; or air drying paints and varnishes for refinishing, all have the property of exceptional durability.

One of the newer Bakelite Materials is a "sandwich" with a sheet of soft rubber firmly bonded between two sheets of fabric base Bakelite Laminated. This material combines flexibility and resiliency with the long life for which Bakelite Products are noted. It is ideally suited for many gasket applications and for machine mountings to reduce vibration and noise.

We illustrate here a few of the hundreds of uses for Bakelite Materials—Molded, Laminated and Varnish, and will be glad to advise upon their advantages for your maintenance work.

Write for illustrated descriptive Booklets 16M, 16L and 16R. Copies by return mail.

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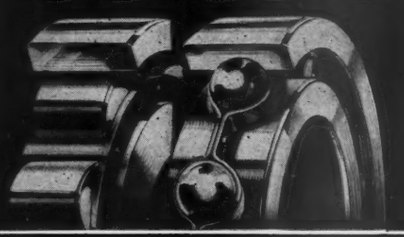
THE MATERIAL OF A THOUSAND USES

TWIN

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ASK FOR CATALOG AND ENGINEERING COUNSEL
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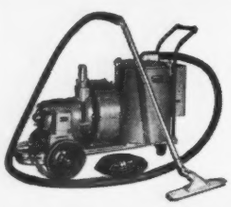

SCATTERING DUST
is not cleaning:
Obsolete brushes and brooms scatter much more dust than they sweep up. Invincible Industrial Vacuum Cleaners take out all dust. They improve products. They reduce dust and fire hazards. They better health and raise the morale of workers. In many cases, Invincibles save as much as 50% of cleaning costs. Ask for complete information.
INVINCIBLE
Portable Vacuum Cleaners (10 Models)
Widely used vacuum tools and INVINCIBLE HOSE
Invincible Vacuum Cleaner Mfg. Co., Dover, Ohio

for the fixed work which is there irrespective of volume. The number of setups for the actual production in comparison with the standard is another factor and, although this must be adjusted at times for unusual happenings such as samples, special service runs, etc., proper administration will permit the usage of this factor as another indication of performance. Inventory turnover, allowed as a differential rate, varying with volume of production, is another factor that must be included. A share of minimum wage allowance reduction and, in the cases where material layouts come under this function, a share of waste reductions are prime factors.

A proper consideration of all these measuring sticks will place a definite goal before the planning manager which quite frequently considerably changes the attitude of the managers of such divisions and produces results far beyond those ordinarily obtained.

Some Planning Short Cuts

In reviewing planning methods one is particularly impressed with the excesses involved in schemes that attempt to detail every operation. Combination description plates or specifications made up with some of the reproducing ink methods quite frequently permit the making up of a single order in a sufficient number of copies to provide one for every department head, thereby eliminating a great many individual operating tickets and postings while simultaneously giving each foreman sufficient advance notice of the detail of jobs ahead.

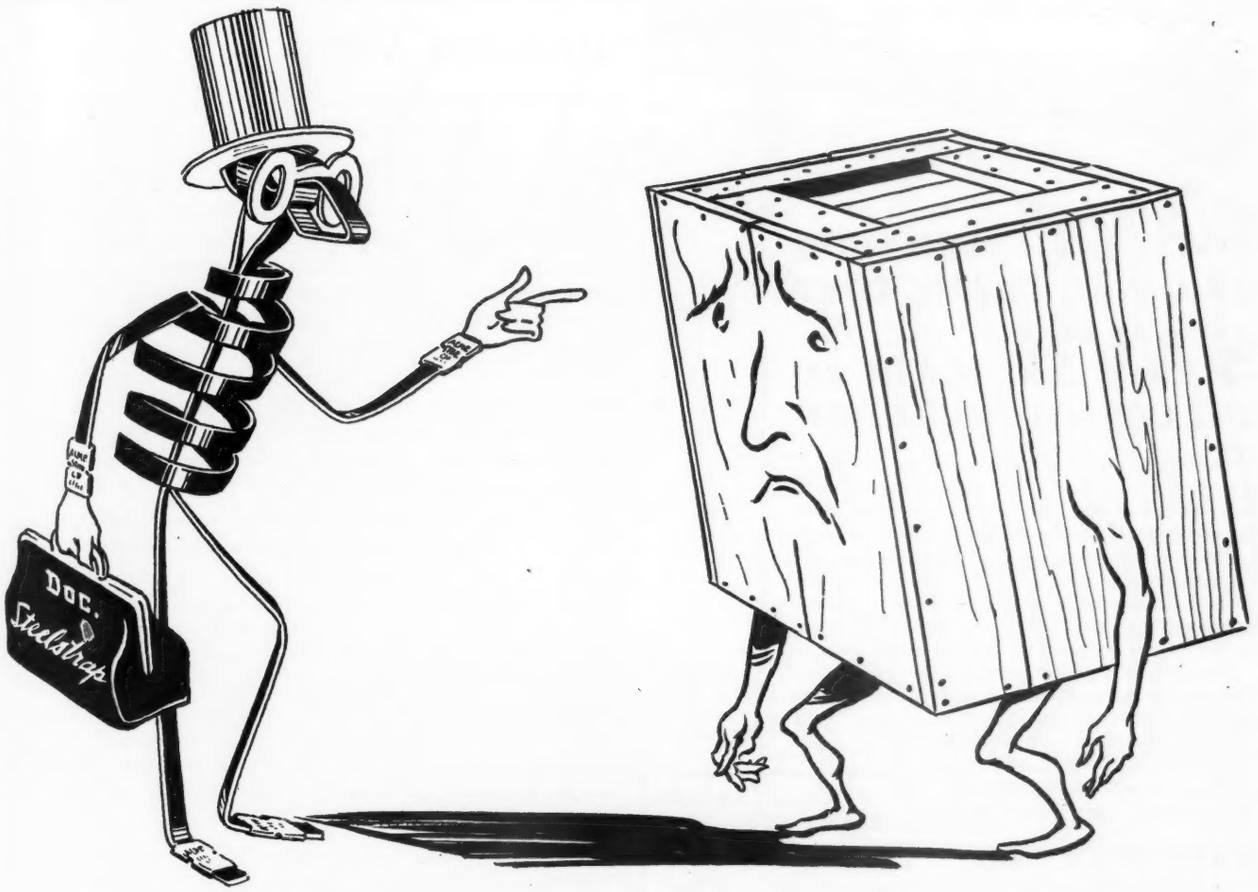
Quite frequently it will be found that highly centralized systems of planning are costly and that a partial decentralization which will accommodate time keeping, cost, and planning requirements simultaneously will more closely place a divisional foreman or superintendent in touch with his production while reducing the aggregate factory clerical cost. Naturally, interpretation of this statement varies considerably with the type of manufacture and organization with which one has to deal.

And in Conclusion

My conclusions boil down to a few statements: It is possible to determine the amount of money that can be saved by a planning division. It will be necessary for a great many of us to change our viewpoint from that of extreme systemization to a more modified and business-like premise. We have gone to great pains in figuring what an economic lot size should be while unfortunately overlooking what an economic planning division size must be. As soon as this function can be placed on a demonstrably self-sustaining basis, it will not be subject to the old service department criticisms.

Planning can control operations completely while simultaneously offering the foreman plenty of opportunity for exercising a nominal degree of judgment. As a system, it is a tool of management, and should be used to aid rather than dominate his activities.

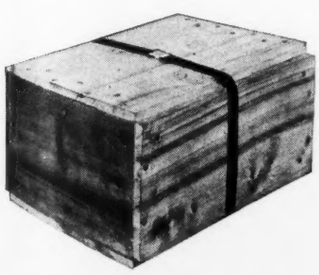
Employees are interested only in the total size of the pay envelope they receive. They invariably compare money with amount of time put in and not amount of work done. Therefore, by accurately gaging time requirements, one not only reduces the amount of minimum wage allowance necessary but also eliminates a chronic cause of labor discontent.



"No Wonder You Feel Tired . . . You're Grossly Overweight!"

BEFORE—*This package is sadly overweight.*

Below *is the re-designed box.*



AFTER—*much lighter, stronger and more economical—with one administration of Steelstrap. It's "Bound to Get There."*

"Bound to get there"

Why, you spend half your strength carrying yourself around. But cheer up, young fellow. I've treated many a case like you—and the results never fail to be good.

Let me work with your shipper a while. Then I'll decide on the most efficient "dosage" of Acme Steelstrap. And *then*—we'll trim down that excess poundage, build up resistance and send you out ready for anything.

What's more, I'll save your shipper many dollars in dead weight eliminated. (It's expensive to have you travel in your present shape.)

Wait till you see how snug and trim you feel with some Acme Steelstrap in your system. Your old friends who used to call you "fatty", will never know you.

My STRAP-BOOK tells of over a hundred different cures effected with Acme Steelstrap on wood boxes, crates, fibre boxes, bundles, skids, etc. It's free to all shippers. I'll also send to any shipper, actual facts and figures on savings made right in his own line of business.

Doc. *Steelstrap*

NRA

Acme Steelstraps

ACME STEEL COMPANY · GENERAL OFFICES: 2835 ARCHER AVE., CHICAGO

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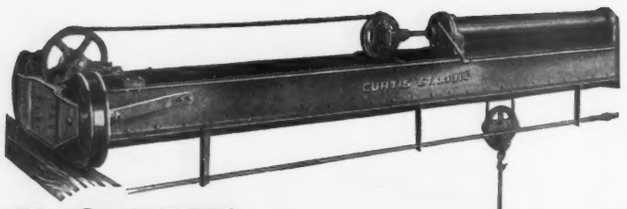


SAVE ½ ON YOUR ORIGINAL CRANE COST

SAVE AGAIN ON THE COST OF OPERATION

HUNDREDS of users of Curtis Air Powered Cranes save the cost of their crane installations the first year. Some report annual savings of two to three times the cost of their Curtis equipment.

The reasons for these remarkable savings are: 1. Curtis Air Powered Cranes cost only half as much as electric cranes in the beginning;—2. they continue to save by requiring practically no repair. 3. They are so simple that common labor can operate them.

In every type of plant where cranes are used, Curtis Cranes give star performance. They do everything that any other crane can do; and some things that no other powered crane can do as well, or at so low a cost.

If you are thinking about a crane, or if you are interested in low production costs, investigate the Curtis.

CONSTRUCTION—

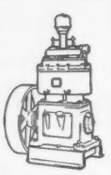
Curtis Air Powered Cranes are available in capacities from 500 pounds to six tons; and in spans from 12'6" to 45'. Ends are pressed steel for maximum strength and minimum weight. Long wheelbase, large diameter wheels, and flexible roller bearings in both Crane and Trolley wheels assure easy movement.

PERFORMANCE—

Curtis Air Powered Cranes handle loads smoothly. Speed is variable and can be controlled. Spots to a hair's breadth. Can't be damaged by overloading. Can't be hurt by heat, fumes, moisture or dust. Requires practically no repairs. Simplicity reduces losses from production interruptions. Operated by common labor.

CURTIS COMPRESSORS

3 to 50 h. p. capacity up to 250 cu. ft. per minute. Water-cooled, "centro-ring" lubrication, higher speeds, controlled temperature head, low oil consumption, less carbon precipitation. Timken Bearings, less friction.



CURTIS AIR HOISTS

Lowest cost power hoist. Laborer can operate. Nothing to get out of order. Fewer production interruptions. Proof against dust, heat and moisture. ½ to 10 ton capacity.

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CURTIS

COMPRESSORS
AIR HOISTS
I-BEAM CRANES and TROLLEYS

Aluminum Arrives

(Continued from editorial page 388)

Or say a 10-ton overhead traveling crane has to be replaced by a 25-ton crane. It is entirely probable that the runways would have to be reinforced—often a costly job. If, on the other hand, aluminum were substituted, the larger crane could operate on the same old runway.

Getting back for the moment to those all-aluminum trains, there is as yet no all-aluminum station for them, but they will feel right at home if ever they venture into the new Cincinnati Union Terminal.

Accentuating the undeniable gaiety is the aluminum metalwork—store fronts, ticket windows and grilles, lighting fixtures, clocks, railings, gates, doors, and so on. Plates, bar stock, simple castings, tubing, and extruded shapes all lend their support to the prevailing motif. Even the handsome marble panels look handsomer because of the aluminum screeds that set them off.

If the all-aluminum station is still somewhere in the offing, the all-aluminum office building, on the other hand, is here. Witness the Department of Public Works Building in Richmond, Va. If some day—which is highly probable—it has to be taken down and put up again on another site, the move can be made with little waste of material. When it was built it had to meet these requirements—low cost, five to ten years' occupancy, high salvage value of materials when and if moved. All-aluminum construction was selected from seventeen different proposals.

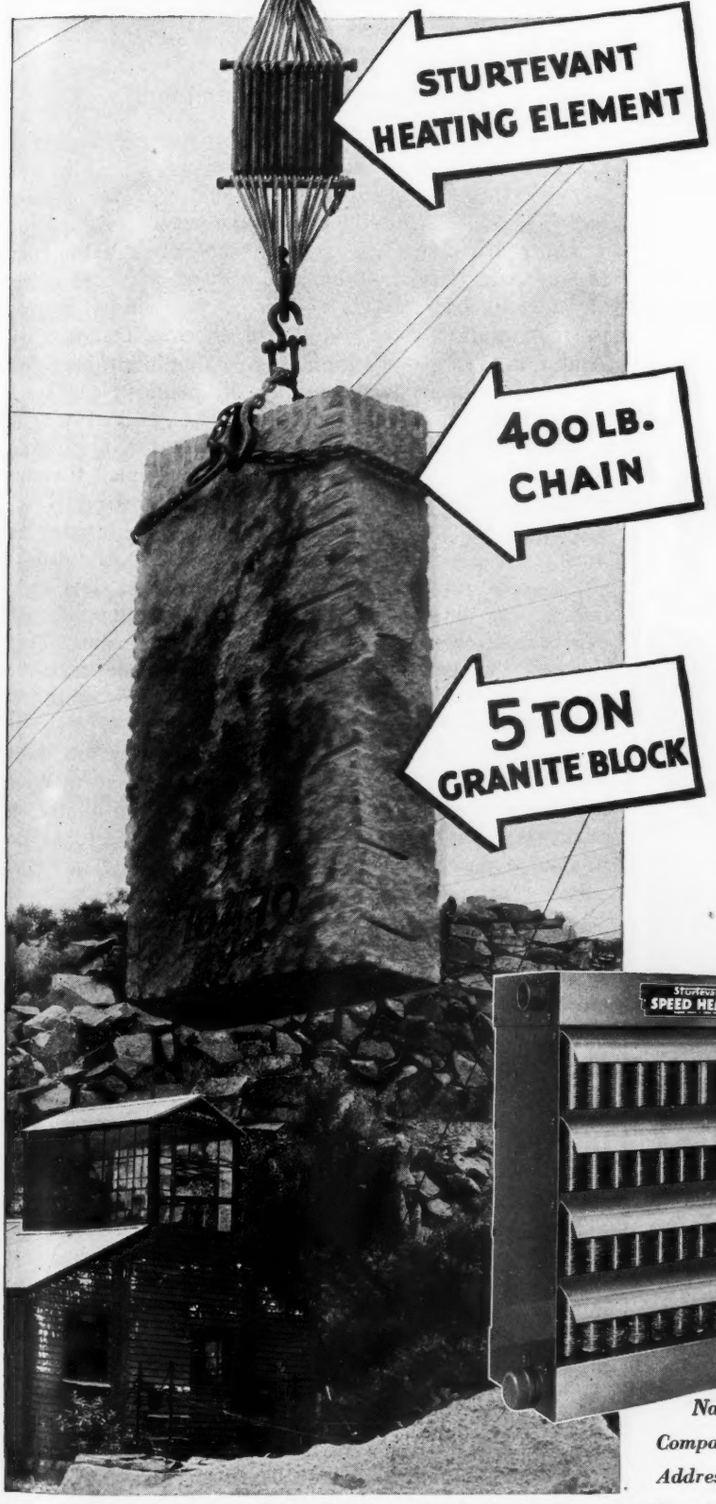
As a Building Material

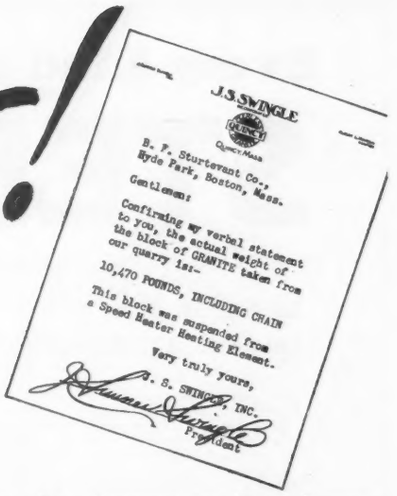
As a building material, aluminum is plastic to the needs of creative design. It is strong, light, resists corrosion, will not streak adjoining surfaces, is readily fabricated and erected. In the building field the blonds are definitely having their day. Chromium plate, stainless steel, and aluminum are in, and aluminum is getting its share. Extruded aluminum shapes unite beautifully with glass to form the modern wall. Aluminum spandrel design is limited only by the designer's imagination. Intricate details are faithfully reproduced.

Aluminum parts for aluminum structures are important. Nuts, bolts, screws, and fittings of that metal not only look better and save weight, but also prevent the electrolytic action that may occur if ferrous or other non-ferrous metals are used. Usually, when the other common metals are used in contact with aluminum, the latter gets the worst of the deal. Copper alloys are especial offenders in this regard, and although insulation will prevent galvanic action, it is far simpler to stick to the one material and avoid all chance of trouble.

Speaking of things all-aluminum—as we were—there is, if you please, the all-aluminum industry. If that statement sounds a little vague, consider the bottle of milk that is dropped each morning on your back porch or your front stoop. On the farm we find aluminum cans, pans, milk pails, ladles, buckets, even milking stools. An aluminum can weighs only half as much as a steel one. Also, its high luster throws radiant heat for a heavy loss and keeps the milk cooler if by chance

Wow!





J. S. SWINGLE

Quincy, Mass.

B. F. Sturtevant Co.,
Hyde Park, Boston, Mass.

Gentlemen:

Confirming my verbal statement to you, the actual weight of the block of GRANITE taken from our quarry is:—

10,470 POUNDS, INCLUDING CHAIN

This block was suspended from a Speed Heater Heating Element.

Very truly yours,

J. S. SWINGLE, INC.

President

IN our last advertisement we showed you a load of 2427 lbs. . . . over a ton . . . hung from the heating element of a Sturtevant Speed Heater. Since that time we've hung this big 5 ton granite block from an identical Sturtevant heating element . . . with no ill effects.

We're trying to find out just how strong our Sturtevant heating elements are. Frankly, we don't know. So we are going to keep piling on the load . . . until we reach the breaking point. See our next advertisement for latest results.

Mail the coupon for Catalog No. 396 describing Sturtevant "Speed Heaters" which are equipped with these strong, absolutely leak-proof heating elements, guaranteed to withstand steam pressures up to 200 lbs. per sq. in.

"Speed Heaters" are made in the greatest available variety of unit heater capacities . . . from 25,000 up to 1,000,000 B.T.U. Shipment from stock of heaters up to 300,000 B.T.U. capacity.

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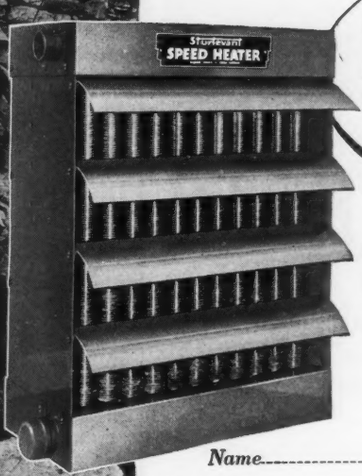

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(*Mail to nearest office*)

☐ Send me Sturtevant Speed Heater Catalog No. 396.

☐ Have your nearby representative call.

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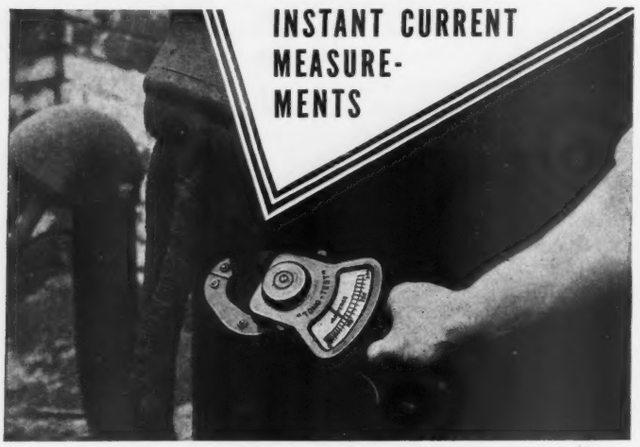


CROMPTON "TONG TEST" AMMETERS

Accurate, light in weight and astonishingly low in cost, the Crompton "Tong Test" will make any A.C. or D.C. reading in five seconds without breaking the circuit.

The "Tong Test" Bulletin completely describes this remarkable instrument—write for a copy.

THE COLUMBIA ELECTRIC MFG. CO.
4519 Hamilton Avenue Cleveland, Ohio

the can stands in direct sun for any length of time.

From the farm the milk can be transported in aluminum truck tanks. They have them up to 3,500 gallons. The truck may have an aluminum body; aluminum foil may be used as insulation. And in the all-aluminum pasteurizing plant we find aluminum tanks, coolers, filters, plate heaters, distributor pipes, brine coolers, collector pans, rails, instrument panels. Aluminum bottle caps will naturally have the call in such a plant, and it would not be strange to find the maintenance department thoroughly sold on aluminum paint. If there isn't an aluminum chair or two in the office, there ought to be.

For Good Beer—Aluminum

As with milk, so with beer. Among the aluminum applications in the modern brewery are brew kettles, steam coils, filters, cooling, fermenting, and storage tanks, yeast tubs and buckets, pasteurizing equipment.

There are plenty of good reasons why. Aluminum is non-toxic; has no influence on taste or color; is not attacked by beer; needs no protective coating; is easy to fabricate, to clean; has high thermal conductivity. And don't forget it's light. An aluminum beer keg of 1-bbl. capacity weighs only 40 pounds; the truck that distributes it hauls more beer, less dead weight.

For the liquor industry there are aluminum closures. They provide protection, assure the customer that the whiskey he buys is the whiskey he ought to get.

Among the more popular aluminum closures are the ones with the handy tear-down tabs, also those with skirts rolled under locking rings in the glass. The lower end of the skirt is scored horizontally, and when the cap is unscrewed it parts at the perforated line. Then there is the dose cup type of seal. It is supposed to be decorative, protects the contents, has other more important, if somewhat nefarious, uses.

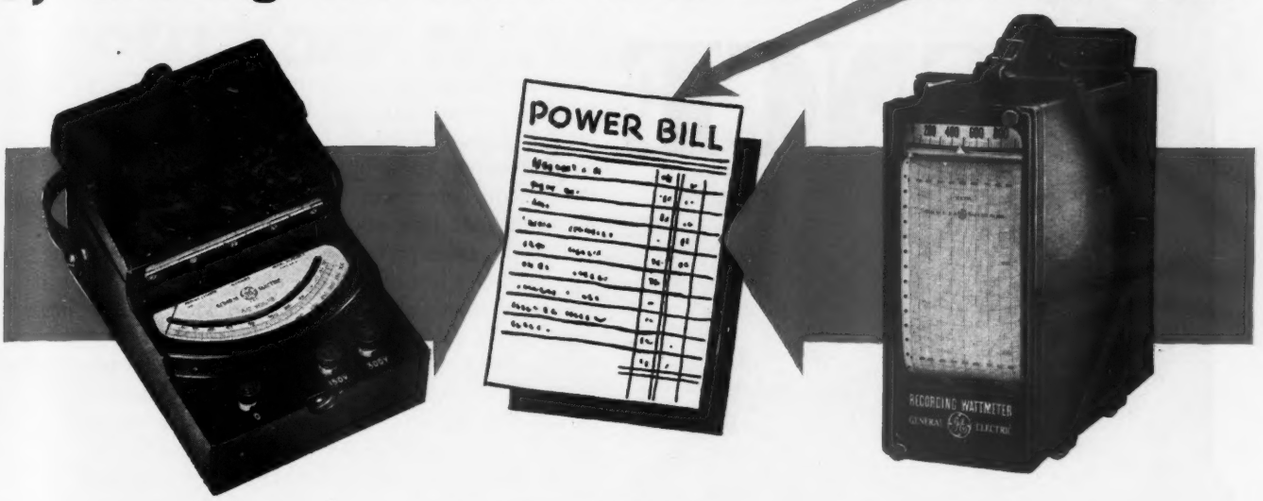
Aluminum foil as an insulating material has been discussed. Need we do more here than barely mention its extensive use in packaging? You've seen aluminum packages here, there, everywhere. Collapsible tubes are of course another familiar application. They carry all sorts of products these days, come in a wide range of sizes, may be decorated—and often are—to suit any taste.

This could go on and on. There is colored aluminum, either plated, or oxide coated and dyed. There is the new electrolytic brightening process which gives aluminum a reflectivity not far below that of silver and provides a reflecting surface that won't tarnish in industrial atmospheres, is resistant to the weather, can be readily cleaned with soap and water. And, lest you forget—and you mustn't—there is aluminum paint. Applied to any surface it hardens into a protecting armor of metallic aluminum, is therefore invaluable in the protection of steel against rust, as a priming coat in wood, as a serviceable and good-looking finish for industrial plants.

Countless other uses could be cited. They would serve only to emphasize the amazing versatility of the metal. Aluminum has come a long way in 50 short years. It is endowed with certain advantages which the other common metals don't have. It has made the best of them. Aluminum has truly arrived, but it is going plenty more places.

YOU'LL SAVE HERE

By Getting the Facts with These Instruments



These Handy Test Instruments Will POINT OUT Expensive Power Leaks

GET the facts with these reliable test instruments. They will save their cost many times over by ferreting out expensive power leaks and increasing plant efficiency.

You can know the operating conditions of your motors and power circuits by using these portable test instruments regularly. They will enable you to spot costly, inefficient, underloaded motors; and unreliable, overloaded motors and power circuits. They may be used to check your lighting circuits to see that your lamps are burning at their rated voltage.

Note in the illustration how compact these instruments are—and how the terminals, glass, and scale are protected by the cover. Remember, too, that these instruments are constructed for permanent accuracy and long-time service, and that their degree of accuracy is higher than that usually required for utility instruments.

Let the RECORDER "Picture" Point the Way to LOWER POWER RATES

G-E recording instruments will give you a "picture" of operating conditions in your plant that is beyond question—a "picture" showing accurately the peaks of load that are so important in determining your power rates.

They will catch and record the facts necessary for analyses of your plant operation. When placed in the power circuits that feed a plant, they will show how much time is wasted, by telling graphically how long it takes, each morning, for the plant to reach normal productive activity. On individual pieces of equipment they will reveal stories of idle time, or show details of operating cycles. On interrelated equipment they will show whether or not each part is performing properly in relation to each other part.

G-E recorders are available in both portable and switchboard types. Their price enables you to have adequate measuring equipment at a very reasonable investment.

Make General Electric your headquarters for electric instruments. Types for practically any application are available in all standard ratings; others will be built to your specifications. For further information, call the nearest G-E sales office, or mail the attached coupon.

GENERAL ELECTRIC

HEADQUARTERS FOR ELECTRIC INSTRUMENTS

General Electric Company
Dept. 6O-201, Schenectady, N. Y.

Portable Test ☐ Recording ☐

Please send me information on the instruments I have checked.

Name.....

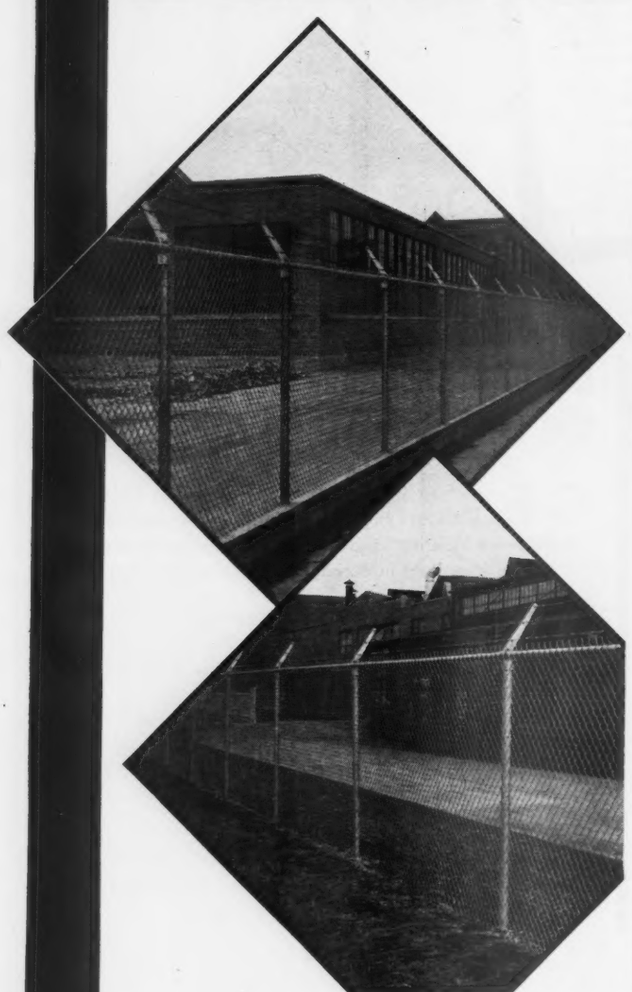
Firm.....

Street.....

City..... State.....

430-45

PAGE FENCE



● Unfenced industrial property is in constant danger. A durable Page Chain Link Fence keeps out undesirables, decreases fire hazards, prevents thievery, makes every foot of your property available for storage purposes. The nearest of eighty-two Page Service Plants will send an expert to advise, erect and guarantee long lasting service. Write to Association headquarters or any one of the District Offices shown below for name of Page Service Plant nearest you.

PAGE FENCE ASSOCIATION
Bridgeport, Connecticut

District offices in ATLANTA, NEW YORK
PITTSBURGH, CHICAGO, SAN FRANCISCO
America's first wire fence—since 1883

NRA CODE

Had to Hire 2,200 Girls Quick

(Continued from editorial page 385)

its moving while the applicant is under test, has a shallow tray on one end, a brass plate on the other.

In the finger test board the brass plate is large enough to accommodate 100 holes drilled at intervals of one centimeter, 10 holes to the row. The holes are large enough so that three brass pins, each about a sixteenth of an inch in diameter, will fit in comfortably. The pins are about an inch long and relatively easy to handle.

For the tweezer test, the brass plate is the same size, but the holes are only large enough for single pins.

The method of testing is simple. The applicant is seated at a table 30 inches high, with the board placed in front about a foot away from the edge of the table. For the finger dexterity test the tray holds 310 pins, which the applicant is required to place three at a time in each hole, starting with the first hole of the top row and continuing row by row in regular order to the last hole of the last row. To acquaint the applicant with the method, the examiner demonstrates the procedure of the test, makes suggestions as to the best way of handling the board, and then permits the applicant to fill in the first row of ten holes for practice. After a short rest, the applicant begins the test, being accurately timed with a stopwatch.

With the second test, the procedure is repeated, but this time the applicant is shown how to use the tweezers and is directed to place a single pin in each hole.

Examiners are instructed not to interfere directly or otherwise with the progress of the test. Also they are to make themselves as inconspicuous as possible while timing. This is to reduce the self-consciousness of the examinee, thereby obtaining a more accurate evaluation of her ability.

Grouped by Test Grades

According to the grades received, applicants are placed in one of four groups—A, B, C, or D. Performance time is taken as a criterion in the grouping. The values for the grouping are given in Table I.

Some applicants do well in both the finger and the tweezer tests. Others do better with one than with the other. One applicant whom we examined and who demonstrated remarkable dexterity had been a hairdresser. Others had been typists or workers in textile mills.

We find that 48 out of each hundred applicants are rejected as being totally unfit for our type of factory work. The finger and tweezer dexterity tests weed out 15 of this number, the others being disqualified because of defective eyesight (3); age and marriage (10); and by personal interview (20).

Dexterity tests divide applicants into the following groupings: Grade A, 17 per cent; Grade B, 22; Grade C, 38; and Grade D. 23. We make our first choice from the A and B groups (see Table II) which represent 39 per cent of those who have taken the tests. Candidates rated C or D are employed for operations where manual dexterity is not necessary.

These Fuses Protect both Your Motors and Payroll

Anybody knows that production interruptions are expensive. Machines and motors must have protection . . . fuses . . . but time-costs need protection, too. Fuses that blow on harmless overloads mean payroll losses.

Jefferson Super-Lag Renewable Fuses are the perfect answer. They provide reliable, *accurate* protection—ride over all harmless surges, operate positively on dangerous overloads. There is no better protection for electrical equipment and property.

Jefferson Super-Lag Fuses are made in all capacities, both knife blade and ferrule types. Save your motors and payroll by specifying Jefferson Super-Lag Fuses.

JEFFERSON ELECTRIC COMPANY

BELLWOOD . . . *Suburb of Chicago* . . . ILLINOIS

The secret of Jefferson Super-Lag performance lies in the lag plate which is a part of the Super-Lag link. This plate delays the normal fuse action to provide a time interval or *lag*. This time-lag prevents the fuse from blowing on harmless temporary overloads—to save needless shutdowns and many link replacements.

JEFFERSON Super-Lag RENEWABLE FUSES

Electrical failures prevented and money saved — by "Megger-Testing"

With 9000 installed h.p. the Chief Engineer reports that they make periodic "Megger" tests on generators and motors, and have saved *"several thousand dollars."* *A Paper Mill in Wisconsin.*

". . . have prevented serious damage and shutdown, and have saved a 250 kva. generator, a 40 h.p. motor and two 20 h.p. motors. . . . The 'Super-Meg' you supplied has proved its value many times." *A Food Products Plant in Indiana.*

"We use your Megger on all the apparatus in the station every month—for I am a firm believer that prevention is better than cure." *Plant Engineer of a Hydro-Electric Plant.*

"The writer feels, personally, that money invested in a set of this kind pays more return on the principal than can be obtained from any other instrument of any character." *Chief Engineer of a Rubber Company in Ohio.*

Please write for Bulletin 1355-F describing the various types of "Megger" instruments.

JAMES G. BIDDLE CO.
1211-13 Arch Street
Philadelphia, Pa.

"MEGGER"

TRADE MARK REGISTERED U.S.PAT. OFF.

A FOUR LEAF CLOVER is our "Mold Mark" and we are justifiably proud of it, for it appears on some of the finest and most intricate Plastic Molded Parts. If you are interested in better Plastic Molded Parts we invite your inquiries.

CHICAGO MOLDED PRODUCTS CORP.
2148 Walnut St. **Chicago, Ill.**

Labor Costs in Advance by Formula

(Continued from editorial page 392)

machine efficiency, we shall get the cost per piece; then should we multiply this figure by 100 times the pieces per foot, we shall get the cost per 100 feet (12), cost being considered as direct-labor cost, of course, in these examples. To write these facts algebraically, let:

P = pieces per foot
R = machine hour rate in cents
RPM = revolutions per minute, or pieces per minute at 1 piece per revolution
E = expected machine efficiency
Z = labor cost or piece price per 100 feet, in cents.

Then:

$$(12)\quad Z = \frac{(100)(R)(P)}{(60)(RPM)(E)} = (1.67)(R)\frac{P}{(RPM)(E)}$$

Since each of the groups has certain unchangeable characteristics, we can develop, by substitution, a specific formula for each group (14) (16) (18), as follows:

Group I, where $E = 0.85$, and

$$(13)\quad R = \frac{60}{18} \text{ or } 3.33$$

Substitute E and R in (12), and we get for Group I:

$$(14)\quad Z = (1.67)(3.33)\frac{P}{(RPM)(0.85)} = 6.54\frac{P}{RPM}$$

and in Group II, where $E = 0.825$, and

$$(15)\quad R = \frac{57}{7} \text{ or } 8.14, \text{ we get:}$$

$$(16)\quad Z = (1.67)(8.14)\frac{P}{(RPM)(0.825)} = 16.48\frac{P}{RPM}$$

and in Group III, where $E = 0.80$ and

$$(17)\quad R = \frac{45}{6} \text{ or } 7.5, \text{ we get:}$$

$$(18)\quad Z = (1.67)(7.5)\frac{P}{(RPM)(0.80)} = 15.66\frac{P}{RPM}$$

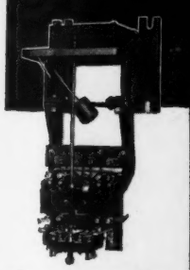
Example III

Of a group of machines one man is to run 4 at 95 per cent machine efficiency for which he will be paid 40 cents per hour. We wish to determine both a labor cost or piece-work price per 1,000 pieces, and the man standard time per 1,000 pieces. The r.p.m. of each machine is different, coil stock is used, and each revolution of the machine produces two finished pieces. Engineering data give us the pieces per coil, and the r.p.m. is obtained from the machine record. Net handling time per coil on any job of this group is 1.34 minutes. The operator is to be allowed 22.7 per cent of the net time for fatigue and personal needs (from which the factor 1.227,

(Continued on page 68)

IS CHANGE ALWAYS PROGRESS?

C-H 9586 "AAA" Starters for 5 h. p. and smaller motors



The same ruggedness and certainty of C-H 9586 "AAA" Starters is brought to other types of C-H control through the use of the same mechanism... Picture shows Bulletin 9586 Explosion-proof Starter, also made in Air-break Type, for Class I, Group D hazards. (Cover removed.)

These Proven Features Recommend Exclusive Use of C-H 9586 "AAA" Starters

1. Heavy silver twin-break contacts render oxidation harmless. Operate on severest inching service at maximum h.p. Carry rated current with less than half permissible temperature rise.
2. Deep non-removable Thermoplax contact-pockets "soak-up" arc. No shields to misplace, no fragile parts. Contacts easily renewed; coils are readily changed. Only needed tool is screwdriver.
3. Twin-break contacts halve arc voltage.
4. C-H Overload Relay provides absolute protection... maximum production. Changes for current-rating and type of motor made simply by changing heater coil.
5. Designed to prevent contacts closing due to jarring, etc., until starter-button is pushed.
6. 60 fewer parts. No pigtails to break. Loosening one screw dismounts entire control-panel. All parts easily accessible and demountable.
7. Convenient wiring channel between case and control panel. All leads brought in top or bottom.
8. Minimum of current-carrying joints. Low contact resistance. Low voltage drop.
9. Stocked by responsible independent electrical wholesalers everywhere.

Finding just another way to do the same thing is not progress. An opposite example is the C-H elimination of 60 commonly used parts in the C-H 9586 "AAA" switching mechanism. That is progress. The "AAA" mechanism challenges all comers; it is based on heavy duty steel mill control design.

Another example is the C-H approach to contact troubles: Why STOP them? Why not see that they do not START? Hence the use here of solid silver shod—not plated—contacts. Silver, the perfect conductor, bright or oxidized. Silver, whose oxide cannot "freeze" contacts.

Yet another: Check the type of arc control. What method is used for disrupting the arc efficiently? C-H "AAA" twin-break contacts halve the arc voltage. The remaining gnat's-eye-sized arc is soaked up in deep Thermoplax pockets.

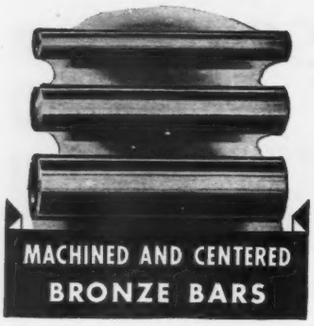
. . . Other reasons for "AAA" supremacy, and "AAA" standardization in many plants, are listed here. Read them. They help explain C-H Motor Control Leadership, and tell why any plant can benefit with C-H Motor Control. CUTLER-HAMMER, Inc., *Pioneer Manufacturers of Electric Control Apparatus,* 1206 St. Paul Ave., Milwaukee, Wisconsin.

CUTLER HAMMER

The Control Equipment Good Electric Motors Deserve

(B-251)

These Are 13″ Bars They Cut Without Waste



The machinist can cut multiples of standard bushing lengths from a Bunting machined and centered bronze bar without excessive waste. Also sufficient stock is provided on the O.D. to permit machining to the size stamped on the bar. There are 116 stock sizes, cored and solid. Write for list, or ask any leading mill supply wholesaler.

The Babbitt With the Lowest Coefficient of Friction

No other babbitt in today's market provides the anti-friction qualities of Bunting Babbitt. Scientific production control assures absolute uniformity in every bar and every shipment. Bunting Babbitt requires a minimum of oil only and is not easily affected by lubrication neglect. Buy it of any leading mill supply wholesaler.

"Ready Made" Bushings for Practically All Applications

There are over 500 different sizes of completely machined and finished Bunting Bronze bushings and bearings available from stock at all times, ready for assembly in all machinery and electrical equipment units. The range of sizes covers every usual need. A glance at the Bunting "Ready Made" list often saves time and labor. Write for it.

THE BUNTING BRASS & BRONZE COMPANY
TOLEDO, OHIO

BRANCHES and WAREHOUSES:
New York, Brooklyn, Newark, N. J., Boston, Philadelphia, Cleveland, Cincinnati, Detroit, Chicago, Minneapolis, St. Louis, Dallas, Kansas City, Los Angeles, San Francisco, Seattle. Export Office: Toledo, Ohio

BUNTING

QUALITY

BUSHINGS · BEARINGS · BARS · PARTS
ANTI-FRICTION BABBITT

used in formula (19), is obtained). Let:

P = pieces per coil
RPM = revolutions per minute (gross)
M = Elapsed minutes (or machine minutes at 95 per cent machine efficiency) per 1,000 pieces
M' = man minutes per 1,000 pieces (at 4 machines per man)
M'' = piece work price per 1,000 pieces.

Without again going into the simple and underlying reasoning which must be performed before setting down an algebraic statement, we get from the foregoing facts formulas as follows:

$$(19)\quad M = \frac{\left[\dfrac{P}{2(RPM)(0.95)} + 1.34\right]1.227}{\dfrac{P}{1{,}000}} =$$

$$\left\{\left[\frac{P}{(1.9)(RPM)} + 1.34\right]1.227\right\}\frac{1{,}000}{P}$$

$$= \left[\frac{(1.227)(P)}{(1.9)(RPM)} + 1.645\right]\frac{1{,}000}{P}$$

$$= \left[\frac{(P)(1.227) + (3.125)(RPM)}{(1.9)(RPM)}\right]\frac{1{,}000}{P}$$

$$= \frac{(1{,}227)(P) + (3{,}125)(RPM)}{(1.9)(P)(RPM)}$$

$$(20)\quad M' = \frac{(1{,}227)(P) + (3{,}125)(RPM)}{(7.6)(P)(RPM)}$$

$$(21)\quad M'' = \frac{0.4}{60}\left[\frac{(1{,}227)(P) + (3{,}125)(RPM)}{(7.6)(P)(RPM)}\right]$$

$$= 0.0067\left[\frac{(1{,}227)(P) + (3{,}125)(RPM)}{(7.6)(P)(RPM)}\right]$$

$$= \frac{(8.21)(P) + (21.95)(RPM)}{(7.6)(P)(RPM)}$$

By the simple expedient of substituting known engineering data on new jobs in the above formulas, our direct labor cost and time are at once found.

Many applications of these derived formulas may be transformed into nomographic charts (sometimes called computing or alignment charts). They give the user mechanical means of solving the equations, without recourse to the substitution of variables in the formulas.

▼

What Type Electric Heating Units?

(Continued from editorial page 412)

must be considered as a chemical and the sheath material selected accordingly.

The melting of soft metals, such as babbitt, tin, and solder, has become one of the major applications of such heating units.

The types of unit used, in the order of their importance, are the cast-in unit which is immersed directly in the metal to be melted, and the plain-sheath, immersion unit.

The cast-in unit consists of a unit formed into the desired shape with molten metal cast completely around it except for the terminals, which project. The metal cast around the unit may be gray iron, aluminum, iron of special analysis, and so on, depending upon the requirements. For the majority of applications gray iron

(Continued on page 72)

"SING A SONG OF STAINLESS"...

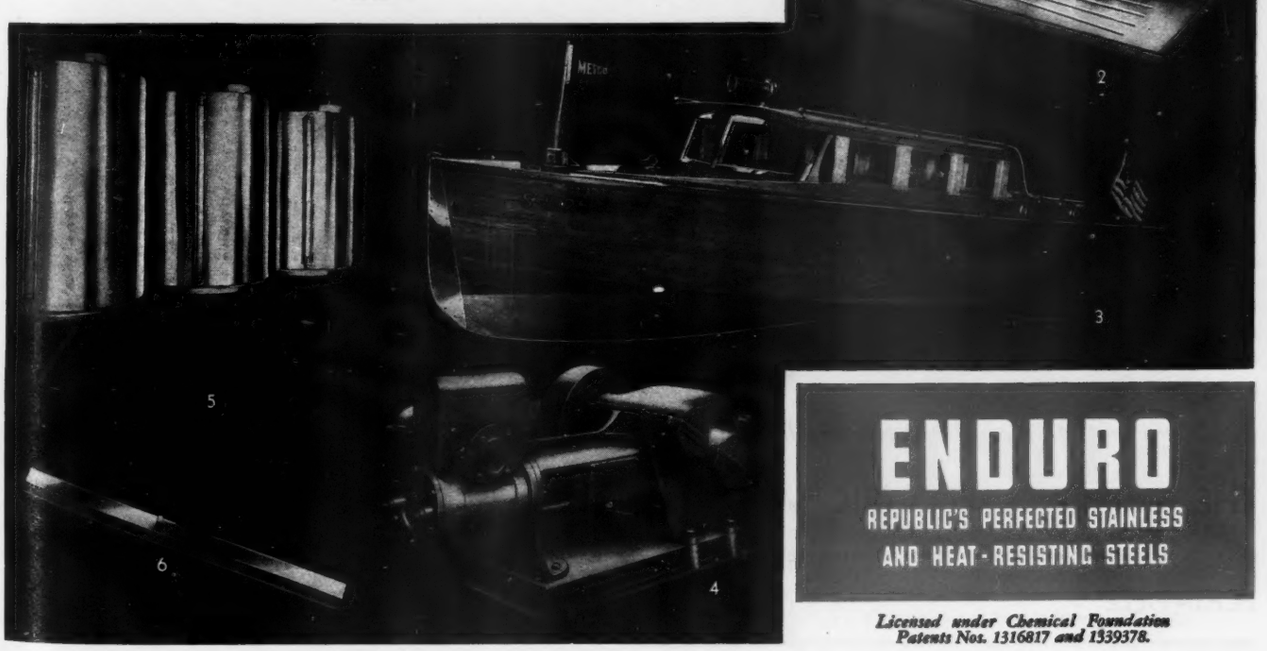
A pocketful of profit awaits the manufacturer who takes advantage of the added sales value that ENDURO Stainless Steel will bring to his products.

Users are demanding better products. Dealers and distributors are united in the search for items that can be sold at a better profit. Arbitrary price increases alone will not turn the trick. There must be added value in the product. ENDURO will supply it.

Here is a metal that beautifies a range or a kitchen sink—that resists salt corrosion in the trim and prow of a speedboat—that resists acid corrosion in chemical tanks and mine pumps—that does not rust in the windshield wiper of your car—in fact, that lasts indefinitely in hundreds of classes of service where ordinary ferrous metal rusts or causes contamination of other materials.

Outline your requirements. Our recommendations may point the way toward greater sales and profits.

1. *Estate Gas Range with trim of* ENDURO *Stainless Steel.*
2. ENDURO *Stainless Sink by Tracy Mfg. Co., Pittsburgh, Pa.*
3. *Cruiser built by Metal Container Co., Chicago, Ill., with trim, window flashing and prow of* ENDURO.
4. *Studs in this Mine Pump are of* ENDURO. *Made by The Brown-Fayro Co., Johnstown, Pa.*
5. *500-Gal. Whiskey Tanks fabricated from* ENDURO.
6. *Autocraft Corporation, Detroit, Mich., now makes Windshield Wipers of* ENDURO.



CENTRAL ALLOY DIVISION . . MASSILLON, OHIO

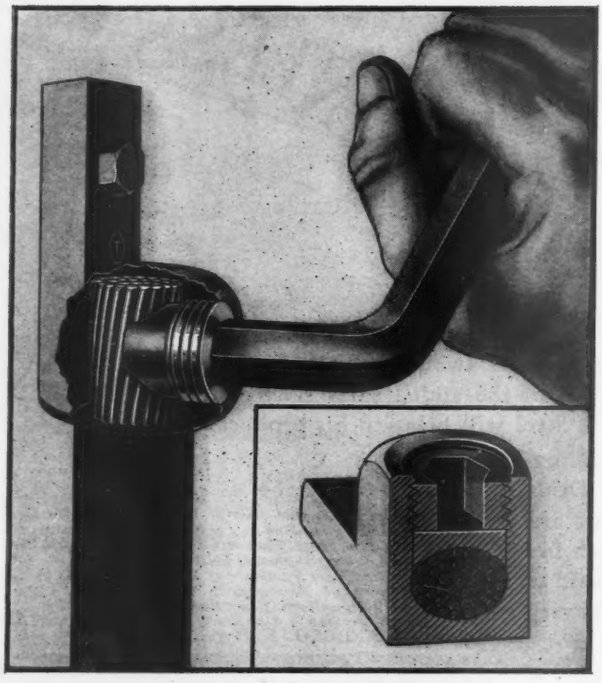
REPUBLIC STEEL CORPORATION

GENERAL OFFICES YOUNGSTOWN, OHIO

ENDURO

REPUBLIC'S PERFECTED STAINLESS AND HEAT-RESISTING STEELS

Licensed under Chemical Foundation Patents Nos. 1316817 and 1539378.



NOW . . . .

A radical improvement in the design of solderless connectors is a feature of the new Trumbull Handi-Lug!

Handi-Lugs being designed and manufactured by a Company *knowing* electrical distribution equipment have many features uncommon to other designs. Eight Handi-Lugs comprise the entire line, taking a range of wire sizes from No. 14 to 1,000,000 C.M.

With only eight lugs making up the set, their adjustable feature is apparent. For example, a 200 amp. lug will take a range of wire sizes from 1/0 to 4/0.

An outstanding feature to maintenance men is in the simplicity of the Handi-Lug design making it possible to use them over and over again —*and for different wire sizes.*

Our regular line of electrical distribution equipment can be furnished in most instances with the new Handi-Lugs or they may be purchased separately.

Write for complete description and listings.

THE TRUMBULL ELECTRIC MFG. CO.

A GENERAL ELECTRIC ORGANIZATION

PLAINVILLE CONN.

is used since it is a very good heat-resisting material and is low in cost.

Placing the heating unit directly in contact with the metal to be melted increases the efficiency of heating and decreases maintenance of the furnace. With suitable automatic temperature control equipment, accurate and fully automatic control of the metal temperature can be obtained.

The maximum metal temperature for which the cast-in unit is available is approximately 1,000 deg. F. Cast-in immersion units may be readily applied to existing fuel-fired melting pots as well as new equipment. It is necessary only to remove the pot and the burner or grate, fill the old combustion chamber with suitable, high-grade insulating material, replace the pot, and install the immersion heating units. It is necessary that the heated portion of the units be kept covered with metal at all times, unless they have been designed for operation otherwise.

Plain-sheath heating units can be obtained in special shapes, or formed by the user. This type of unit can be wrapped around the pipe, clamped to metal parts, or cast into metal.

When a plain-sheath unit is to be applied to a metal surface, it should be placed in suitable machined grooves and tightly clamped. Provision should be made for having at least 50 per cent of the area of the sheath in contact with the metal to be heated.

The following table shows the maximum watts density permissible on the sheath of the unit, calculated from the total active area, for various common sheath materials. It is assumed that 50 per cent of the area of the sheath is in contact with the metal plate to be heated, and that the unit is tightly clamped to this plate.

	Max. Watts per sq.in. on Unit With Surrounding Metal at		
Sheath Material	*400° F.*	*575° F.*	*750° F.*
Steel	25	12	..
Nickel silver	40	30	18
Calorized steel	..	35	25
12-14% chrome steel	..	40	30

Where a unit is to be applied in contact with an irregular-shaped casting, it may not be possible to machine grooves for the unit. In that case a condition much superior to mere surface contact can be obtained by casting in a groove having a V-shaped bottom, which will insure contact with at least two points on the unit over its entire length, provided a tight clamp is applied. Under these conditions the maximum watts per square inch will be approximately 60 per cent of the values given in the table.

▼

How to Maintain Instrument Accuracy

(Continued from editorial page 415)

having several potentials corresponding to the voltages used in the plant; an ammeter and a wattmeter, each of 5-amp. capacity, with several current transformers, the ratios of which correspond to the current capacities of the switchboard meters in use.

D.C. instruments are tested by a voltmeter and milli-

NEW FIREPROOF PLANK*

handles like wood, cut, nailed, sawed or bored

GYPSTEEL GYPSUM FLOORS AND ROOFS WILL NOT ROT, SHRINK OR WARP

For Floors, Roofs, Ceilings, Partitions—use this new fireproof *Plank*. *Gypsteel Gypsum Plank* saves time and money in construction because it's easy to handle and eliminates form work. And it saves hundreds of dollars later on heating costs, on insurance, on repairs, and on destruction caused by vermin, rodents and termites.

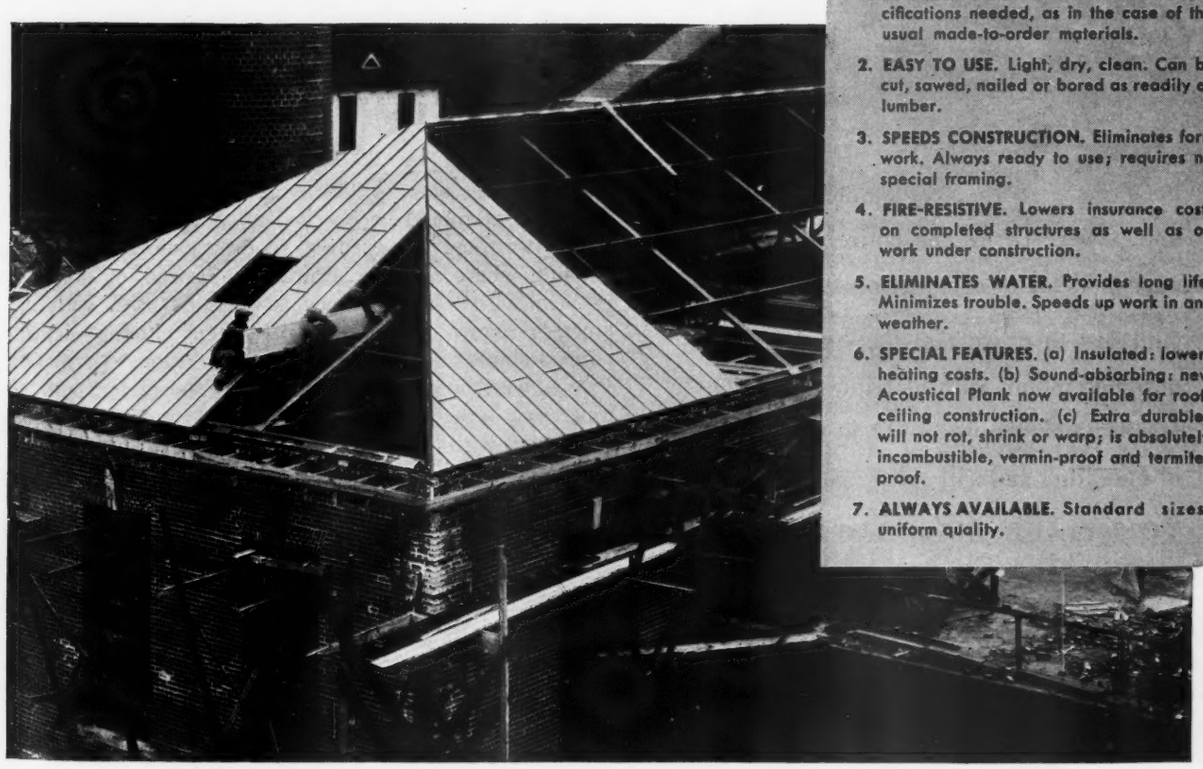
Read the 7 features listed below. Then write today for full details on this amazing Gypsteel development.

WHAT IT IS. *Gypsteel Gypsum Plank* is a solid slab of factory-cast dense gypsum, tongued and grooved on sides and ends with galvanized copper-bearing steel. It is light, strong, incombustible, and can be cut, sawed, nailed or bored like wood.

In the oil industry such well-known concerns as the Sinclair Refining Company, the Texas Company, the Standard Oil Companies of New Jersey and Pennsylvania, the Kendall Refining Company and others have used Gypsteel Gypsum Plank successfully.

7 time-saving and money-saving features

1. **SIMPLIFIES PLANNING.** No detailed specifications needed, as in the case of the usual made-to-order materials.
2. **EASY TO USE.** Light, dry, clean. Can be cut, sawed, nailed or bored as readily as lumber.
3. **SPEEDS CONSTRUCTION.** Eliminates form work. Always ready to use; requires no special framing.
4. **FIRE-RESISTIVE.** Lowers insurance costs on completed structures as well as on work under construction.
5. **ELIMINATES WATER.** Provides long life. Minimizes trouble. Speeds up work in any weather.
6. **SPECIAL FEATURES.** (a) Insulated: lowers heating costs. (b) Sound-absorbing: new Acoustical Plank now available for roof-ceiling construction. (c) Extra durable: will not rot, shrink or warp; is absolutely incombustible, vermin-proof and termite-proof.
7. **ALWAYS AVAILABLE.** Standard sizes, uniform quality.



FREE! Write today for free bulletin giving full information on *Gypsteel Gypsum Plank*, together with valuable facts on floor loads, acoustics, termites, etc. No obligation whatever. Simply address Structural Gypsum Division of American Cyanamid and Chemical Corporation, 30 Rockefeller Plaza, New York.

GYPSTEEL PLANK gypsum

Trade-Mark

U. S. Pat. No. 1,854,396 Canadian Pat. No. 328,519
Other U. S. and Foreign Patents Pending

**The term PLANK as applied to cementitious building products is a registered trade-mark of the Structural Gypsum Division of American Cyanamid and Chemical Corporation.*

Let's talk performance, maintenance cost and power. Throw the entire field wide open and make comparisons.

And just to prove that the special Thor designed motor, with its triple insulation and its hand forming, will lower your cost of operating and will give greater service,

YOU MAKE THE COMPARISON.

We will send you for ten days any Thor electric tool. Use it on the hardest materials. Run it continuously for hours. Compare it with any other drill manufactured,

THEN DECIDE.

TOOL MAKERS SINCE 1893

INDEPENDENT PNEUMATIC TOOL CO.

604 W. JACKSON BLVD., CHICAGO, ILL.

NEW YORK SAN FRANCISCO

voltmeter with shunts of various capacities. A rotating standard is not suitable for checking d.c. watthourmeters because of inaccuracies that arise from the temperature coefficient, stray magnetic fields, friction, and other causes. The approved method of test involves the use of an ammeter, a voltmeter, and some timing device such as a stop watch or synchronous clock.

Checking switchboard instruments while in service is fairly simple. To check a voltmeter, the test meter or standard as well as the switchboard instrument is connected to the same points on the line. A d.c. ammeter, generally used with an external shunt, may be tested by connecting a millivoltmeter across the same shunt terminals. The millivolt drop of the shunt for which the indicating instrument has been calibrated is known, so it is simple to calculate the accuracy of the meter under test.

In testing a d.c. watthourmeter, the voltage and current are measured by the voltmeter and the ammeter respectively and the product of their readings gives the true watts. The speed of its rotating element being ascertained, the accuracy of a meter can be determined by consulting the watthour constant of that particular instrument. Calibrating data and watthour constants of these meters should be obtained from the manufacturers.

The methods of calibrating both a.c. and d.c. watthourmeters are carefully outlined by the makers and should be followed without deviation. Calibrations of indicating types of voltmeters, ammeters, and wattmeters are hardly practicable in the average plant. Have them done by the manufacturer or by a service laboratory.

Frequency of Checking

Indicating and graphic ammeters, voltmeters, and wattmeters should be checked about four times a year. D.C. watthourmeters may require calibration once a month, where extreme accuracy is desired, or only once a year where less accuracy is needed. A.C. watthourmeters require less attention. Their moving elements are lighter, their construction is more permanent. D.C. watthourmeters and amperehourmeters of the mercury type should be dismantled and the mercury replaced with "chemically clean" mercury at nine to eighteen-month periods. The instrument must be calibrated after the mercury is replaced. Routine checking for accuracy should be done every month or at least every three months.

In any plant using many instruments, the ideal setup is to have the care and routine testing of meters handled by an individual who will keep complete and concise records. From the figures tabulated concerning indications, behavior, peculiarities, etc., a chart of operation may be plotted. Any great variation indicates that the instrument should be taken out of service and repaired or corrected. A switchboard and bench are desirable for general testing. Certain instruments can be checked more readily at a bench than on the switchboard. The bench is also convenient for inspecting and testing instruments before they are put into service.

One last "must." The testing equipment selected for checking throughout the plant must itself be checked and calibrated periodically. Unless you have the standardization apparatus for doing this properly, don't take a chance. Send it to a laboratory.

VENTURAFIN METHOD OF HEATING

Wins HANDS DOWN

on Every Count Against Toughest Competition

In a recent test conducted in a great industrial plant under actual operating conditions* American Blower Venturafin Unit Heaters scored a sensational victory over seven competitive makes, proving itself the quietest, speediest, most efficient method of heating. Result, another large order for Venturafin Unit Heaters. Naturally, you expect such performance from a half-century old specialist in air handling equipment. And just as naturally you will want to take advantage of such economy and such efficiency when you re-vamp or supplement your present heating system. Units are carried in stock in more than 100 cities. For complete information call in your local heating contractor or phone the nearest American Blower Branch Office.

AMERICAN BLOWER CORPORATION, DETROIT, MICHIGAN
CANADIAN SIROCCO CO., LIMITED, WINDSOR, ONTARIO
BRANCH OFFICES IN ALL PRINCIPAL CITIES
Division of American Radiator and Standard Sanitary Corporation

*Plant name will be furnished on request.

Capacity and Economy

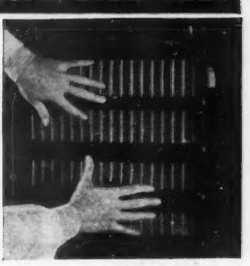
Streamline coil design gives maximum heating surface and minimum air resistance.

Quieter in Operation

Venturafin Unit Heaters are uniformly quiet. The smaller sizes for offices and commercial installation have patented three-point spring suspension insuring the minimum of noise.

Faster, More Even Heat

Same degree of heat instantly over entire heater area. Direction of warm air current is controllable by simple adjustment.



HEAT WITH UNIT HEATERS

American Blower
"Sirocco" VENTILATING, HEATING, AIR CONDITIONING, DRYING, MECHANICAL DRAFT
DIVISION OF AMERICAN RADIATOR and STANDARD SANITARY CORP.

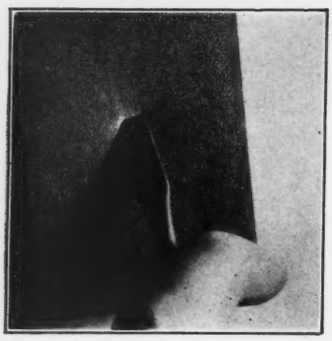
AMERICAN BLOWER CORPORATION, 6000 Russell Street, Detroit, Mich.
Please send complete data on Venturafin Unit Heaters to:

*Name*_____ *Firm Name*_____

*Address*_____

*City*_____ *State*_____ (1313)

SCHIEREN-IZED



The soft yielding surface which makes an unusual Pulley Gripping Quality, is created by the Schieren-izing process.

Two ways to cut your power costs are—

1 Use the modernized group form of driving machines.

(We will send you gratis a folder summarizing the savings that can be effected in FIVE different kinds of plants.)

2 Use Schieren-ized Leather Belting.

CUBAN BELTING

Chas. A. Schieren Company

Tanners and Manufacturers of LEATHER BELTING, PACKINGS and SPECIALTIES

Main Office and Factory
72 FERRY STREET NEW YORK, N. Y.
Tanneries: Bristol, Tenn.

SCHIEREN-IZING
Puts a grip
in Belting

(Continued from editorial page 420)

degrees Centigrade, to avoid damage.

The point of magnetic saturation can be found by running the generator unloaded at normal speed and applying field current gradually. Read the voltage for every ampere, or fraction, increase in field current. Plot the values of voltage and current, with volts as ordinates and amperes as abscissas. If a curve is drawn through the points plotted, somewhere along it a point will be found where an increase in field current will no longer raise the voltage.

If the design of the generator permits, the field polepieces may be taken out and shims placed under them in order to bring them closer to the armature. Ample allowance should, of course, be left for bearing wear.

The third expedient is to increase the speed as much as safety will allow. It will be well to get the recommendations of the manufacturer on this point.

Possibly some combination of these methods will be necessary in order to get the desired results.

CLARENCE W. HOPE, *Lowell, Mass.*

What Alloy Will Stand Zinc Sulphate Solution?

We use steam pumps to handle a 30-degree Baumé solution of zinc sulphate containing some cadmium, copper, and nickel compounds, among other impurities. The pumps are bronze-fitted, but the bronze fails rapidly, becoming porous, pitted, and brittle. This trouble is noticed especially on the valve stems and seats. Can readers suggest some other alloy that would give better service here? It is necessary to avoid contamination by iron. We attribute the difficulty to substitutions brought about by the positions of the metals mentioned above, in the electrochemical series. Are we correct in making this assumption?

D. D.—Chicago

THE FACT that the parts failing become porous, pitted, and brittle indicates that electrolytic action or chemical replacement is taking place. The solution used lends itself readily to electrolytic action. This type of corrosion is probably more frequently met than is generally realized.

In this case the valves and valve stems may be of a different composition than the other metals with which the solution comes in contact.

It would seem that the first thing to do is to make sure that all parts are of the same composition. If this is the case the alloy is of such nature that at least one metal is being replaced, and the alloy should be changed. In order to meet a similar problem, an easily replaceable plug was installed at one point in our equipment. This plug was made of a metal that is high enough in the electrochemical series to be dis-

Idle Time of Machinery!

Do you know EXACTLY how much on each machine ?
Press A-26
mill #2
A—Didn't get started until 9 A. M.
B—Stop of 40 minutes—waiting for material
C—A hearty lunch!
D—Three 10-minute stops—machine jammed, poor material.
E—Operative left machine for half an hour. Why?
F—Plenty of time to wash up! Quitting time not until 5:00.

The Servis Recorder Tells You AT VERY LOW COST

See how "time down" stands out on the chart above. You can't miss it. You can't help but reduce it!

Suppose you could reduce idle time on all your factory machinery nearly 10 minutes a day! What would it amount to in a year—or even a month! More than you'll ever save by "little economies."

This little "time clock for machinery," the *Servis Recorder,* bolts or clamps right on to the machine itself—no ink, no pencils, no electric wires. Send for folder, "A Busy Plant."

THE SERVICE RECORDER COMPANY
1422 Euclid Ave., Cleveland, O.

THE SERVIS RECORDER
The "Time Clock" for Machinery

Dolph's

ELECTRICAL INSULATING QUARTETTE

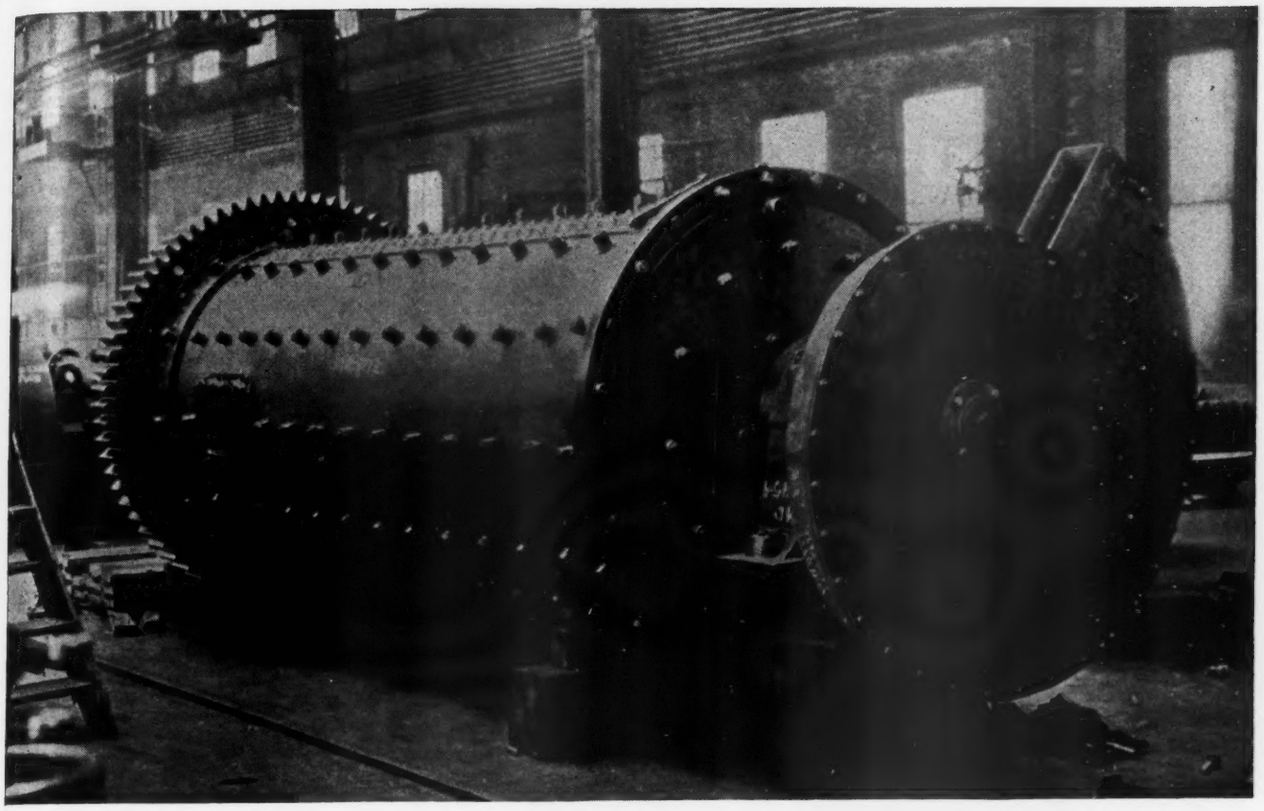
Covers All Requirements for Maintenance and Repair

Dolph has taken the uncertainty out of the selection of insulating varnishes. Each member of the Quartette has been designed for a specific industrial maintenance need and can be depended upon to meet that need adequately.

- **Dolph's Coil Black Air Drying—** for armature and coil insulation before assembling
- **Dolph's Black Finishing Varnish** Air dries in thirty minutes and is a waterproof black finish for meter boards, cables, feeders, etc.
- **Dolph's Electric Lacquer** the standard oilproof varnish and waterproof black finishing varnish for 25 years
- **Dolph's Red Oilproof Enamel** for use on mica cones and commutator ends to prevent trouble from oil creepage

Write for Descriptive Pamphlet

JOHN C. DOLPH CO.
Insulation Specialists
168 EMMET STREET
NEWARK . . . . N. J.



The machine with a rubber gizzard!

FIFTY tons of mineral ore grind and crunch between steel balls rolling inside a sheet of rubber. The mineral is pulverized . . . the rubber is unharmed!

Ore-bearing rock used to be crushed at the mines in ball mills lined with 3 inch manganese steel. But the steel "couldn't take it"—a few months of such punishment and the metal was worn through.

A mining engineer came to Goodrich with an idea, and Goodrich engineers went to work. Rubber in a thousand different compounds had performed a thousand different miracles—why not this one?

A tough, resistant rubber was developed, tried, perfected. Today there are ball mills lined with 1 inch rubber which have been crushing rock for *six years*, when a few months was all the toughest 3 inch steel could stand. Capacity of the mills is enlarged, production is further increased by eliminating frequent shutdowns, maintenance costs are reduced, there is less vibration and noise.

Resistance to abrasion is only one of many discoveries in compounding rubber. This amazing material can now be so made that it will flex almost indefinitely; will resist oil, heat, chemicals and oxidation; will recover its shape after repeated stretching and pressure; will take almost any form, texture and color. These improvements are being used in countless products today to reduce vibration, noise, and wear, to prolong product life, to increase product appeal.

If you have not investigated Goodrich developments in rubber and how they might be applied to your product or process, you may be needlessly wasting money or losing sales. Rubber is on the march to new usefulness in industry. Take advantage of it. The B. F. Goodrich Company, Mechanical Rubber Goods Division, Akron, Ohio.

Goodrich

ALL *products problems* IN RUBBER

The

"LITTLE LANDIS"

A new machine for jobbing and maintenance threading

The "LITTLE LANDIS" Pipe Threading and Cutting Machine is designed to thread, ream, and cut-off pipe, and thread bolts, rods, etc. in jobbing and maintenance shops.

The primary purpose of the machine is to provide means for handling work at a minimum cost, to permit of the quickest possible set-up changes, and to produce cleanly cut, accurate, well-formed threads on all materials.

In building the "LITTLE LANDIS," the ever-present thought has been to offer a machine thoroughly tried and proven—a machine of unquestioned ability, and of unquestioned quality.

Write today for literature.

LANDIS MACHINE COMPANY

Fifth Street

Waynesboro, Penna.

solved in preference to the regular fittings, but that would not harmfully contaminate the solution. By watching and renewing this plug as necessary the remainder of the equipment was protected.

Aluminum bronze or phosphor bronze have been found to be fairly satisfactory in a relatively neutral zinc sulphate solution. Both of these alloys are listed as being resistant to dilute sulphuric acid. Both can easily be machined; hence, pump parts can be made from then without difficulty. J. P. SIMONS
Lakewood, Ohio

Motor Reverses Rotation

Can someone tell me why a 5-hp. compound, d.c. motor that drives a woodworking machine reverses its direction of rotation just before it reaches normal speed? This motor had not been in service for some time; so when we had use for it recently it was completely overhauled. When we tried to operate it after it had been installed it seemed to start all right but before it reached full speed it stopped and began to run in the opposite direction. At the same time, the fuses blew. The same thing happens every time we try to start it, although the fuses do not always blow. The motor seems to be in good condition otherwise, and I should like to know how to keep it going in the proper direction. R.D.—Birmingham, Ala.

THERE is little doubt that the trouble is due to reversal of either the series or the shunt field connections. The motor is now operating as a differentially wound machine, whereas it was originally a cumulative compound motor.

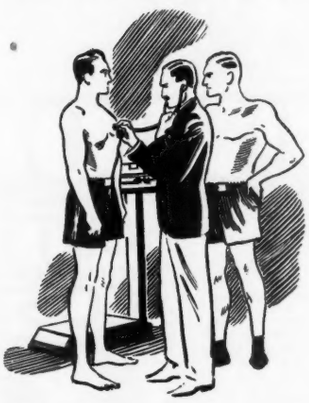
If the series field was not tampered with at the time the motor was overhauled, the shunt field connections were. Obviously, the remedy is to reverse the circuit through either the series or the shunt winding. If the motor has no commutating pole windings, either the series or the shunt field can be reversed. With interpoles the matter is not quite so simple. However, if R. D. will check the polarity produced by the series field alone and then produce the same polarity by energizing the shunt field alone the connections will be correct for operation as a compound-wound motor. The interpole polarity can then be corrected if it is found to be wrong.

The polarity of any main pole of the motor must be the same as that of the interpole just ahead of it, with regard to the direction of rotation of the armature. In other words, if a certain point on the surface of the armature is passing under a North pole, the interpole under which the point will pass a moment later must also be a North pole.

CHAS. A. PETERSON, *South Bend, Ind.*

Have your roofs inspected by *Barrett*

. . . a valuable service **FREE** to building owners



Roof Inspection by Barrett has been likened to the physical examination given prize-fighters before a title bout. It is primarily a precautionary measure—assurance that the roofs will stand up under any punishment that the weather may inflict. It does not always mean that repairs will be found necessary, or even advisable.

An examination of your roofs by a trained Barrett Roof Inspector will answer vital questions affecting the proper maintenance of your buildings.

The Barrett Inspector will check your entire roof, parapet walls, copings, etc., and give you a carefully considered, impartial report on conditions found. He will suggest repairs that are advisable; or, if none are necessary, he will tell you so. His knowledge is based on roofing experience accumulated during Barrett's 80 years "Between the World and the Weather."

Inspection is a regular feature of Barrett Roof Service. Every Barrett Specification Bonded Roof is inspected by Barrett. The same inspection is now available to owners of flat roofs, whether Barrett or not. Phone, wire or write our nearest office, and we will gladly arrange an inspection for you. There is no charge or obligation.

THE BARRETT COMPANY, 40 RECTOR STREET, NEW YORK, N. Y.
2800 So. Sacramento Ave., Chicago, Ill. Birmingham, Ala.
In Canada: The Barrett Company, Ltd., 5551 St. Hubert Street, Montreal, P. Q.

RECOVER RIGHT WITH *Barrett* ROOFS

HAVE YOU LEARNED THIS ABOUT SLINGS?

● Ask crane operators, engineers, plant superintendents who have had experience with braided slings what they think of them. They will tell you that braided slings give many times longer service than ordinary sling equipment. Time studies and performance records prove it.

Macwhyte braided slings (patented) are made of multiple parts of wire rope spliced endless and then braided. They are non-kinking, non-spinning, highly flexible. And they provide *positive safety.*

Write for catalog, complete data and performance records.

Macwhyte Company • Kenosha, Wisconsin

ADV. NO. 132

MACWHYTE
WIRE ROPE BRAIDED
Slings

(Continued from editorial page 424)

HARD FACING—Booklet, "The Maintenance of Reciprocating Parts."—The Linde Air Products Co., 30 E. 42nd St., New York.

INSTRUMENTS—Bulletin 188, "Wet and Dry Recording and Controlling Instruments for Humidity and Drying Processes."—The Foxboro Co., Foxboro, Mass.

INSTRUMENTS—Price Sheet 7 for Catalog 123, describes Type NPD d.c. and Type NPA a.c. portable measuring instruments.—Roller-Smith Co., 233 Broadway, New York.

LIGHTNING ARRESTERS—Bulletin No. 375, 160 pages, "Crystal Valve Lightning Arresters."—Electric Service Supplies Co., 17th and Cambria Sts., Philadelphia.

MONEL METAL, NICKEL—Booklet, "The Application of Monel Metal and Nickel to Industrial Processing Equipment."—The International Nickel Co., 67 Wall St., New York.

MOTOR STARTER—Folder, "EC&M No. 1 Type Z0 Weather-Proof Dust-Tight Across-the-Line Motor Starter."—Electric Controller & Mfg. Co., 2700 E. 79th St., Cleveland.

PORTABLE ELECTRIC TOOLS—Catalog No. 37, on Electric Drills, Grinders, Buffing and Polishing Machines.—The Standard Electric Tool Co., 1938 W. Eighth St., Cincinnati.

PUMPS—Folder, describes, illustrates Rex Speed Prime Pumps.—Chain Belt Co., Milwaukee.

PUMPS—Bulletin W-101-B1, Horizontal Duplex Piston Pumps for General Services.—Bulletin W-311-B1A, Single-Stage Volute, Type R, Centrifugal Pumps.—Worthington Pump & Machinery Corp., Harrison, N. J.

PUSH BUTTON—Folder "New EC&M Double-Unit Type J Push Button."—Electric Controller & Mfg. Co., 2700 E. 79th St., Cleveland.

RELAYS—Sec. 41-350, describes Type SG auxiliary relays.—Westinghouse Electric & Mfg. Co., East Pittsburgh, Pa.

RESISTORS, RHEOSTATS—Catalog No. 10, has eight pages of information concerning use of resistors and rheostats in electrical work.—Ohmite Mfg. Co., 636 N. Albany Ave., Chicago.

RESPIRATOR—Bulletin CR-1, illustrates, describes M.S.A. "Comfo" respirator.—Mine Safety Appliances Co., Pittsburgh, Pa.

SCREEN—Catalog No. 1462, on line of vibrating screens.—Link-Belt Co., 910 S. Michigan Ave., Chicago.

SCREW STEEL—Bulletin, "Better Parts Production with Union Free Cut."—Union Drawn Steel Co., Massillon, Ohio.

SEALING COMPOUND—Folder, describes Ideal "Perfect Seal," non-soluble, non-oxidizing, non-corrosive, heat-resisting compound.—Ideal Commutator Dresser Co., Sycamore, Ill.

SHAFTING — Bulletin, "Turned and Ground Shafting."—Union Drawn Steel Co., Massillon, Ohio.

STARTERS—GEA-1979, describes G-E reduced-voltage starters, auto-transformer type (manual, CR1034 and magnetic, CR-

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May Save
YOUR WHOLE
INVESTMENT

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UNDERWRITERS LABELED
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EXTINGUISHERS
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Just one of the many fire extinguishers on duty in your plant may save your entire investment in case of fire. Be sure every one is a Queen, and you'll get that quick, dependable action that has made this line famous for 25 years. Check your plant today for *danger spots!*

Extinguishers and Parts For Every Purpose

Write for prices on new equipment, parts, and refills.

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Safety Supplies—Gas Masks, Goggles, etc.

PYROIL
(Simply Add to Regular Oil)

CUTS *maintenance* COSTS

Pyroil is the latest scientific achievement in lubrication. Simply *added* by the ounce to the regular oil and grease, it cuts friction, overheating, wear and damage because it sheaths all frictional metal with a heat-proof, wear-resisting surface of protection, which constantly renews itself. Actually *makes metal self-lubricating.* Cuts operation costs.

Mail coupon for a FREE COPY of new Pyroil Industrial Brochure, illustrating, classifying and tabulating many important Pyroil facts and uses.

Genuine Pyroil is Manufactured, Patented and Guaranteed by Pyroil Company, W. V. Kidder, Pres., 465 LaFollette Ave., LaCrosse, Wis., U.S.A.

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Please send a Free copy of the new Pyroil Industrial Brochure, as described.
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★The CHIPS tell the Story...

Is *leafing* important? Here is proof! Throw a bushel of large wooden shingles and the same quantity of tiny chips into a pool of water. The shingles will float in irregular piles, with wide gaps showing, while the tiny chips will overlap closely, with few gaps, and cover a far wider area.

Like the shingles, the larger pigment particles in ordinary aluminum paint "leaf" inefficiently—sluggishly, collecting in uneven piles with gaps between—and naturally cover only a limited area. But Permite's tiny pigment particles—fine-screened and vacuum-exploded—"leaf" like the chips. They overlap closely in the sprayed or brushed paint vehicle and spread out evenly over a wide area.

This is why Permite spreads 50 per cent farther than ordinary aluminum paint; why it hides better; lasts longer. Made in two types: Non-Corrosive and Heat-Resisting.

100% LEAFING★ Saves Many Dollars for Users of PERMITE

For your next paint job, how would you like to buy *fifteen* gallons of paint instead of *twenty*? Such saving is made possible by the 100 per cent leafing power of Permite Ready-Mixed Aluminum Paint . . . for this efficient leafing actually assures 50 per cent greater coverage.

Also, your Permite-painted job will stand up, brilliant and protective, long after ordinary paints would fail.

Send for interesting booklet describing why Permite costs less "by the foot."

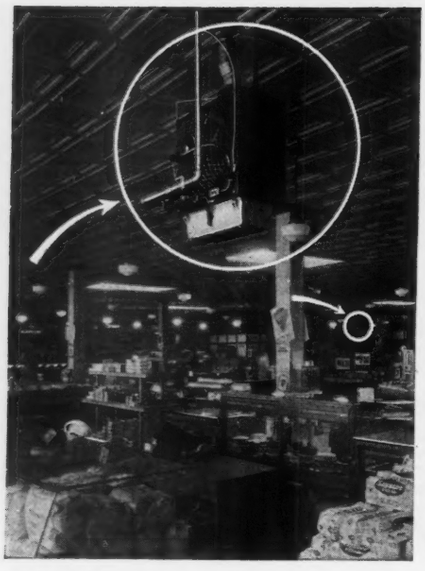
ALUMINUM INDUSTRIES, INC.

CINCINNATI, OHIO

Permite Distributors in All Principal Cities

PERMITE Aluminum PAINT

COSTS LESS "BY THE FOOT"



Clean Heat

with Flexibility and Economy

Here's the kind of installation where absolutely no dirt from heating equipment is permissible. In this big store, four Buffalo No. 150-G Gas Unit Heaters are supplying all the heat to the entire satisfaction of the owners.

And are these heaters flexible—! No variation in winter's temperature is too great or too sudden for the automatic regulation of these units, which operate only a comparatively few hours a day.

This, of course, means real operating economy, anywhere that the gas rate is within reason. Hundreds of Buffalo Gas Unit Heaters are giving *more heat* for *less money*—and with a minimum investment.

Write us giving dimensions of building to be heated, type of wall and roof construction, and B.t.u. value of available gas, and we'll be glad to quote on units to handle your heating job. No obligation.

Buffalo Forge Company
471 Broadway, Buffalo, N Y.
In Canada: Canadian Blower & Forge Co., Ltd., Kitchener, Ont.

"Buffalo" GAS Unit Heaters
Suspended and Floor Types

7051) for squirrel-cage induction motors.—General Electric Co., Schenectady, N. Y.

TOOLS—Bulletin 2037-A, "The World's Most Popular Pneumatic Tools."—Ingersoll-Rand Co., 11 Broadway, New York.

TOOLS—Folder, describes Stanley nonsparking tools of wrought beryllium copper for maintenance and production work in explosive atmospheres.—Stanley Tools, New Britain, Conn.

TRANSMISSION—Booklet T-6700, presents engineering facts about Reeves Variable Speed Transmission.—Reeves Pulley Co., Columbus, Ind.

TUBE COUPLINGS—Bulletin No. 37, lists and describes Parker tube couplings and associated equipment.—Parker Appliance Co., 10320 Berea Rd., Cleveland.

TUBE FABRICATING EQUIPMENT—Bulletin No. 28, lists and describes equipment for bending tubes in quantity.—Parker Appliance Co., 10320 Berea Rd., Cleveland.

VALVE—Bulletin No. 104, describes an air compressor air cushion valve.—Pennsylvania Pump & Compressor Co., Easton, Pa.

VALVE—Bulletin No. V-102, illustrates and describes Nordstrom lubricated plug valve adapted to gate valve dimensions.—Merco Nordstrom Valve Co., 400 Lexington, Homewood, Pittsburgh, Pa.

V-BELT—Bulletin L-400-B3, "Multi-V-Drive with Good Year Emerald Cord Belts."—Worthington Pump & Machinery Corp., Harrison, N. J.

V-BELT—Engineering Data Book, 1934 edition.—Manhattan Rubber Mfg. Div., Raybestos-Manhattan, Inc., Passaic, N. J.

WELDER—Form 10M7-34, data on the Lincoln "Shield Arc" Welder.—The Lincoln Electric Co., Cleveland.

WELDING — Booklet, "The Shielded Arc."—The Lincoln Electric Co., Cleveland.

WELDING—Pamphlet, 8 pages, "The Progress of Bronze-Welding."—The Linde Air Products Co., 30 E. 42nd St., New York.

WELDING—Booklet, 24 pages, "The Testing and Qualification of Welders."—The Linde Air Products Co., 30 E. 42nd St., New York.

WELDING TIMERS—L-20619, on electronic contactor timers for spot welding.—Westinghouse Electric & Mfg. Co., East Pittsburgh, Pa.

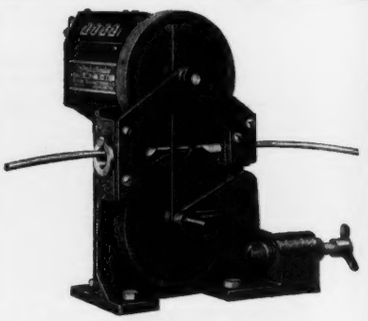
WIRE ROPE—Bulletin, "Sandy tells the boss about his trip to the Pacific Coast."—Macwhyte Co., Kenosha, Wis.

WIRES, CABLES—Booklet, "Electrical Safecote Conductors, Building Wires, and Cables."—General Cable Corp., 420 Lexington Ave., New York.

BOOKS

THE EMPLOYMENT EXCHANGE SERVICE OF GREAT BRITAIN

T. S. Chegwidden and G. Myrddin-Evans, of the British Ministry of



Wire Measuring

Wire Measuring Machine L-16 is a very handy and sturdy *Productimeter* for giving accurately the footage in lengths of Wire, Cable, Rope, Cord, Twining, or small leather Belting.

Designed for manufacturers, and users for checking footage run off. At end of run a brake stops the counting wheels which are quickly reset.

There is a *Productimeter* for almost any product. What have you to count or measure?

DURANT MFG. CO.
1918 N. Buffum St. Milwaukee, Wis. **181 Eddy St. Providence, R. I.**

Productimeters
THE SPEEDOMETERS OF INDUSTRY

Great Tensile Strength

VEELOS BALATA BELTING

VEELOS

Genuine

BALATA BELTING

Before leaving the factory every Veelos Balata Belt is thoroughly stretched to the full limit, while under heat, and then held under heavy tension while allowed to cool. During this process, the Balata Gum permanently fixes every fiber of the duck with which it has become homogeneously united, giving a greater tensile strength than any other belt. The resulting absolute uniformity in width, thickness and balance, insures true and smooth running on the pulleys.

MANHEIM MANUFACTURING AND BELTING CO.
Main Office and Factory: Manheim, Pa.
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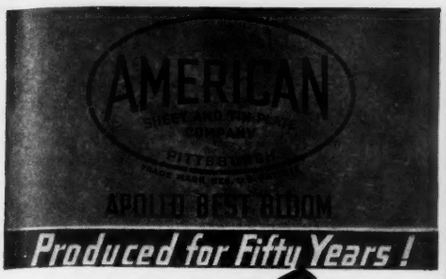
350 Broadway New York City **565 W. Washington Blvd. Chicago, Ill.**



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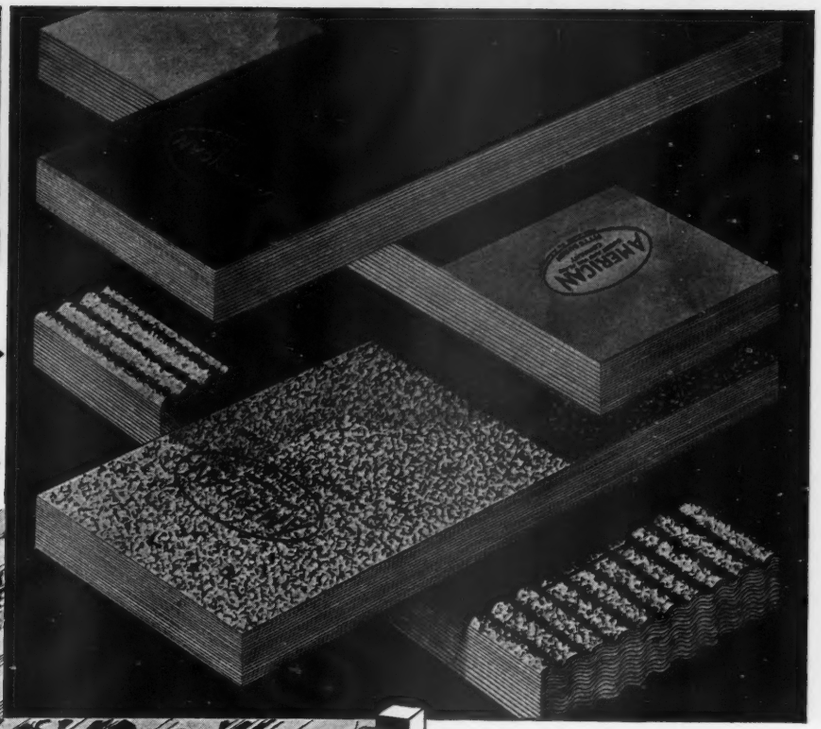

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STEEL SHEETS *for Every Purpose*

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APOLLO Best Bloom Galvanized Sheets

IT IS *fifty years* now since APOLLO Best Bloom Galvanized Steel Sheets were first offered for the use of industry. No other brand of galvanized sheets in this country or elsewhere has since been bought and used in equal volume. Lasting and satisfactory service must have been given.

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Fiction, intensely interesting, portraying the evolution of the steel industry. Pictures a background of relentless "big business," driving plant management, oppressed labor. Timeliness obvious.

On the Calendar

SEPTEMBER

6, Ninth Annual Industrial Extension Conference, Rutgers University. N. C. Miller, Director, University Extension Division, Rutgers University, New Brunswick, N. J.

10-14, American Chemical Society, 88th meeting, Cleveland. Charles L. Parsons, Secretary, Mills Bldg., Washington, D. C.

18-20, Association of Iron and Steel Electrical Engineers, 30th convention, in conjunction with Iron and Steel Exposition, Cleveland. J. F. Kelly, Managing Director, Empire Building, Pittsburgh, Pa.

20-22, National Industrial Advertisers' Association, 12th annual conference, Cincinnati. H. V. Mercer, Chairman of Exhibit Committee, American Rolling Mills Co., Middletown, Ohio.

27-29, Electrochemical Society, 66th convention, New York. Colin G. Fink, Columbia University, New York.

OCTOBER

1, National Safety Council, annual meeting, Cleveland, National Safety Council, 20 N. Wacker Drive, Chicago.

1-4, Illuminating Engineering Society, 28th annual convention, Baltimore, Md., D. W. Atwater, General Secretary, 29 West 39th St., New York.

1-5, American Society for Metals, annual convention, New York. W. H. Eisenman, Secretary, 7016 Euclid Ave., Cleveland.

1-5, National Metal Congress and Exposition, Commerce Hall, Port of New York Authority Bldg., New York, W. H. Eisenman, Secretary, 7016 Euclid Ave., Cleveland.

10-11, Society of Automotive Engineers, Production Meeting, Detroit. John A. C. Warner, General Manager, 29 W. 39th St., New York.

15-18, American Institute of Accountants, annual meeting, Chicago, John L. Carey, Secretary, 135 Cedar St., New York.

22-26, American Foundrymen's Association, 38th annual convention, and Fifth International Foundry Congress, Philadelphia. C. E. Hoyt, Secretary, 222 W. Adams St., Chicago.

DECEMBER

3-8, Eleventh National Exposition of Power and Mechanical Engineering, New York. Charles F. Roth, International Exposition Co., Manager, Grand Central Palace, New York.

3-8, American Society of Mechanical Engineers, 56th annual meeting, New York. Calvin W. Rice, Secretary, 29 W. 39th St., New York.

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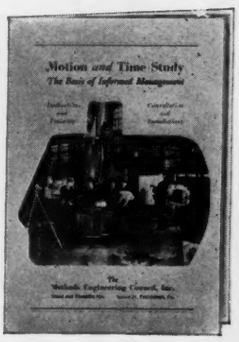

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